DOCUMENT RESUME

ED 235 274 UD 023 124

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TITLE Senior High School Earth Sciences and Marine Sciences.
INSTITUTION Duval County Schools, Jacksonville, Fla.
PUB DATE 82
NOTE 128p.; A publication of the Division of Instruction.
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01/PC06 Plus Postage.
DESCRIPTORS Behavioral Objectives; Course Descriptions; *Earth Science; High Schools; *Marine Biology; *Marine Education; Research Projects; Resource Materials; *Science Curriculum; Science Education; *Science Instruction; Secondary School Science; Space Sciences; Student Research

ABSTRACT

This guide was developed for earth sciences and marine sciences instruction in the senior high schools of Duval County, Jacksonville, Florida. The subjects covered are: (1) Earth Science for 10th, 11th, and 12th graders; (2) Marine Biology I for 10th, 11th, and 12th graders; (3) Marine Biology II, Advanced, for 11th and 12th graders; (4) Marine Science for 10th, 11th, and 12th graders; (5) Science Survey, Earth/Space for 10th, 11th, and 12th graders; and (6) Science Research, Advanced, for 11th and 12th graders. For numbers (1) through (5), the following are provided: notes to the teacher, performance objectives, course outline, key recommended instructional materials, and key to laboratory resources. In science research, students are expected to complete an independent research project and general recommendations are provided for this. (CMG)

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SENIOR HIGH SCHOOL EARTH SCIENCES and MARINE SCIENCES

UD 023124

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1982

SENIOR HIGH SCHOOL
EARTH SCIENCES AND MARINE SCIENCES

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Marine Science	MS
Science Research	SR
Science Survey, Earth/Space	SS-E/S

CURRICULUM DEVELOPMENT AND MLST STATUS

SECONDARY SCIENCE COURSES

1982-1983

COURSE	GRADE LEVEL	CURRICULUM	MLST
Anatomy and Physiology	SHS	No changes	On line
Biology I	SHS	No changes	On line
Biology I, Adv.	JHS/SHS	Slight revisions	On line
Biology II, Adv.	SHS	New	Field Test
Chemistry I	SHS	No changes	On line
Chemistry I, Adv.	SHS	Slight revisions	On line
Chemistry II, Adv.	SHS	New	Field Test
Earth/Physical Science, Adv.	JHS	New	Field Test*
Earth Science	SHS	No changes	On line
Earth Science 9	JHS	New	Field Test
Ecology	SHS	No changes	On line
Life Science 7	JHS	No changes	On line
Life Science 7, Adv.	JHS	No changes	On line
Marine Biology I	SHS	No changes	On line
Marine Biology II, Adv.	SHS	Major revisions	Field Test
Marine Science	SHS	Slight revisions	On line
Physical Science 8	JHS	Slight revisions	On line
Physical Science II	SHS	No changes	On line
Physics I	SHS	Slight revisions	On line
Physics I, Adv.	SHS	No changes	On line
Physics II B, Adv.	SHS	New	Field Test
Science Survey, Biol.	SHS	No changes	On line
Science Survey, E/S	SHS	No changes	On line
Science Survey, Phys.	SHS	Slight revisions	On line
Zoology	SHS	Slight revisions	On line

* In 10 junior high schools; students in all other schools take on-line MLST.

INTRODUCTION
EARTH SCIENCE

State Accreditator Number. .	1343
Course Code Number	2230
F.T.E. Category.	1.10
Instructional Level.	Standard
Report Card Abbreviation . .	Earth Science
Length of Course	Year
Credit	1 Science credit
Grade Level.	10, 11, 12

Prerequisites

None

Textbook(s)

Ramsey, W. L., et al, Modern Earth Science (New York: Holt, Rinehart, and Winston, 1979).

Notes to Teachers

Changes have been made in the content and format of the Course Outline and in the Performance Objectives for Earth Science. The full objectives as well as the minimum level skills objectives are included in this product.

The Minimum Level Skills (MLS) objectives are indicated with an asterisk (*), and will be the only objectives tested in the Minimum Level Skills Test (MLST). The "Teaching Time" listed on the "Key to Instructional Materials" is a suggested maximum for each objective to help insure that all MLS objectives can be met by MLST time.

Laboratory skills are indicated with a plus sign (+). Suggested resources for teaching the laboratory skills have been listed at the end of this section of the teacher's guide. Teachers may substitute other resources for the indicated laboratory investigations. Additional laboratory investigations are encouraged. Since further curriculum development will occur for this course, it is suggested that teachers keep a record of additional laboratory investigations and their source. In both the instructional materials key and the laboratory resources key, resources are listed in rank order of importance.

EARTH SCIENCE

1.0 Research Skills

- 1.1 Metric Measurement
  - *1.1.1 Metric units
  - +1.1.2 Measurement laboratory
  - +1.1.3 Density: determination
- 1.2 Scientific Method
  - *1.2.1 Hypothesis
  - *1.2.2 Control
  - *1.2.3 Graph interpretation
  - 1.2.4 Conclusions
  - +1.2.5 Hypothesis development

2.0 Astronomy

- 2.1 Instruments
  - *2.1.1 Optical
  - +2.1.2 Telescopic observations
  - 2.1.3 Radio telescope
  - *2.1.4 Spectroscope
- *2.2 Galaxy
- 2.3 Sun
  - 2.3.1 Temperature
  - *2.3.2 Fusion
  - 2.3.3 Disturbances
  - 2.3.4 Energy source
- 2.4 Stars
  - *2.4.1 Doppler effect
  - 2.4.2 Magnitude: apparent, absolute
  - 2.4.3 Life history
- 2.5 Earth Motions
  - *2.5.1 Rotation/ Revolution
  - 2.5.2 Inclination/ Seasons
- 2.6 Moon
  - 2.6.1 Origin
  - +2.6.2 Diameter determination
  - 2.6.3 Phases
  - *2.6.4 Lunar eclipse
  - *2.6.5 Tidal bulge
- 2.7 Solar System: Origin
- 2.8 Planets
  - *2.8.1 Order
  - 2.8.2 Characteristics

3.0 Geology

- 3.1 Minerals/Rocks
  - *3.1.1 Minerals/Rocks: definitions
  - *3.1.2 Identification tests: minerals
  - +3.1.3 Mineral identification
  - *3.1.4 Rocks: igneous, sedimentary, metamorphic
  - +3.1.5 Rock classification
  - 3.1.6 Conservation
- *3.2 Crust/Mantle/Core
- 3.3 Plate Tectonics
  - 3.3.1 Crustal plates
  - 3.3.2 Mid-ocean ridges/ Sea-floor spreading
  - 3.3.3 Volcanoes: causes
  - *3.3.4 Volcanoes: shapes
  - 3.3.5 Volcanoes/ Plate tectonics
- 3.4 Crustal Movements
  - *3.4.1 Folding: anticline, syncline
  - 3.4.2 Faulting
  - 3.4.3 Earthquakes/ Faults
  - *3.4.4 Focus
  - *3.4.5 Seismograph

* Indicates Minimum Level Skills
\+ Indicates Laboratory Skills

EARTH SCIENCE

- 3.5 Weathering/Erosion
  - *3.5.1 Weathering: mechanical, chemical
  - 3.5.2 Soil formation
  - 3.5.3 Erosion: gravity, wind
  - 3.5.4 Erosion: glaciers
  - +3.5.5 Weathering experiment
- 3.6 Water Resources
  - *3.6.1 Water Cycle
  - 3.6.2 Permeable/ Impermeable
  - 3.6.3 Water table
  - *3.6.4 Aquifer
  - 3.6.5 Local resources
- 3.7 Shorelines
  - 3.7.1 Weathering: sea waves
  - 3.7.2 Sand dunes
- 3.8 Historical Geology
  - 3.8.1 Principle of superposition
  - *3.8.2 Index fossil
  - 3.8.3 Life forms
  - 3.8.4 Geologic column

4.0 Oceanography

- 4.1 Measurement
- 4.2 Physical Properties
  - *4.2.1 Ocean floor: features
  - 4.2.2 Sediment
  - +4.2.3 Sediment experiment
  - 4.2.4 Temperature/ Depth
- 4.3 Chemical Properties
  - *4.3.1 Salinity
  - +4.3.2 Hydrometer construction
  - 4.3.3 Temperature/ Gases
- 4.4 Economic Benefits
- 4.5 Ocean Movements
  - 4.5.1 Circulation patterns
  - +4.5.2 Density currents
  - 4.5.3 Waves
  - *4.5.4 Tides
  - *4.5.5 Erosion
  - +4.5.6 Heating rate

5.0 Meteorology

- 5.1 Atmosphere
  - *5.1.1 Gases
  - 5.1.2 Chemical balance
  - 5.1.3 Greenhouse effect
- 5.2 Wind
  - *5.2.1 Convection
  - +5.2.2 Heat transferral
  - 5.2.3 Coriolis effect
  - *5.2.4 Wind belts
- 5.3 Moisture
  - *5.3.1 Relative humidity
  - +5.3.2 Relative humidity: measurement
  - +5.3.3 Dew point: determination
  - *5.3.4 Condensation: forms
  - 5.3.5 Precipitation: causes, types
  - 5.3.6 Precipitation: measurement
- 5.4 Weather Change
  - 5.4.1 Air masses: origin
  - 5.4.2 Air masses: names
  - *5.4.3 Front
  - 5.4.4 Warm/Cold front
- 5.5 Weather Forecasting
  - *5.5.1 Instruments: functions
  - 5.5.2 Weather map
  - 5.5.3 Forecasts

EARTH SCIENCE

5.6 Local Weather
- 5.6.1 Breeze formation: land, sea
- *5.6.2 Precautions: hurricane, tornado

5.7 Climate
- *5.7.1 Climate: definition
- 5.7.2 Control
- 5.7.3 Zones

6.0 Earth Measurement

6.1 Earth: Shape/Size
- 6.1.1 Sphere
- 6.1.2 Directions/ Locations

6.2 Maps
- 6.2.1 Projections
- 6.2.2 Uses
- 6.2.3 Scale

6.3 Topographic Maps
- 6.3.1 Contour lines
- 6.3.2 Contour interval
- 6.3.3 Symbols
- 6.3.4 Elevation
- 6.3.5 Stream direction
- 6.3.6 Point Location: township, range

PERFORMANCE OBJECTIVES
EARTH SCIENCE

To demonstrate the ability to recall and apply knowledge of research skills, astronomy, geology, oceanography, and meteorology, students will master the performance objectives listed below. Successful completion of this course is based on teacher judgement and the requirement that students pass the Minimum Level Skills test.

Performance Objectives

1.0 Research Skills

1.1 To demonstrate knowledge of metric measurement, students will:

*(1) identify metric units of mass, length, and volume;

+(2) measure mass, length, and volume using appropriate laboratory equipment; and

+(3) determine density of a material using appropriate laboratory procedures.

1.2 To demonstrate knowledge of the scientific method, students will:

*(1) select a hypothesis when given appropriate data;

*(2) identify an example of a control when given a description of an experimental procedure;

*(3) interpret a graph from recorded earth science data;

(4) draw conclusions from experimental data; and

+(5) use laboratory procedures to develop hypotheses and to identify controls.

---

* Indicates Minimum Level Skills
\+ Indicates Laboratory Skills

2.0 Astronomy

2.1 To demonstrate knowledge of the instruments used in astronomy, students will:

*(1) identify a description of a refracting telescope and a reflecting telescope;

+(2) observe astronomical bodies with a telescope;

(3) discuss the advantages and disadvantages of a radio telescope; and

*(4) identify the spectroscope as the instrument which collects information about the composition of the stars.

*2.2 Students will identify a definition of a galaxy.

2.3 To demonstrate knowledge of the sun, students will:

(1) discuss the temperature differences from the core to the corona;

*(2) identify atomic fusion as the source of the sun's energy;

(3) explain solar disturbances and their effect on earth; and

(4) discuss the use of solar energy as an alternative energy source.

2.4 To demonstrate knowledge of stars, students will:

*(1) identify the Doppler effect as a means of showing relative motion of the stars;

(2) discuss the use of apparent and absolute magnitude in the classification of stars; and

(3) describe the stages in the life history of a star.

2.5 To demonstrate knowledge of motions of the earth, students will:

*(1) identify the effects of rotation and revolution; and

(2) describe the relationship between the inclination of the earth and the seasons.

2.6 To demonstrate knowledge of the moon, students will:

(1) describe the stages in the theory of the origin of the moon;

+(2) determine the diameter of the moon using appropriate laboratory equipment;

(3) identify the moon's phases;

*(4) identify the position of the sun, earth, and moon when given a diagram of a lunar eclipse; and

*(5) identify a tidal bulge as an example of the effect of the moon's gravity on the earth.

2.7 Students will describe the nebular theory of the origin of the solar system.

2.8 To demonstrate knowledge of the planets, students will:

*(1) identify the correct order of planets according to their distance from the sun; and

(2) describe individual characteristics of the planets.

3.0 Geology

3.1 To demonstrate knowledge of minerals and rocks, students will:

*(1) identify the definitions of mineral and rocks;

*(2) identify mineral identification tests: color, streak, luster, cleavage, fracture, and hardness;

+(3) identify mineral samples using laboratory procedures;

*(4) identify a definition of igneous, sedimentary, and metamorphic rock;

+(5) use laboratory methods to classify rock samples as igneous, sedimentary, or metamorphic; and

(6) explain the importance of conservation of our mineral resources.

*3.2 Students will identify on a diagram the location of the crust, mantle, and core.

3.3 To demonstrate knowledge of plate tectonics, students will:

(1) draw an outline of the major crustal plates when given a map of the earth;

(2) explain the relationship between mid-ocean ridges and sea-floor-spreading;

(3) describe the major causes of volcanic activity;

*(4) identify shield, cinder, and composite as the three major cone shapes; and

(5) explain how volcanism is related to plate tectonics.

3.4 To demonstrate knowledge of crustal movements, students will:

*(1) identify anticline and syncline when given a diagram of a folded rock;

(2) describe the movement which occurs during faulting;

(3) explain the relationship between earthquakes and faulting;

*(4) identify the definition of focus; and

*(5) identify the function of a seismograph.

3.5 To demonstrate knowledge of weathering and erosion, students will:

*(1) identify examples of mechanical and chemical weathering;

(2) explain how soil is formed;

(3) describe the roles that gravity and wind play in erosion;

(4) describe how glaciers erode the land; and

+(5) demonstrate physical and chemical weathering using laboratory procedures.

3.6 To demonstrate knowledge of water resources, students will:

*(1) identify the processes which make up the water cycle;

(2) distinguish between permeable and impermeable;

(3) explain how the water table is related to the water in the ground;

*(4) identify the Floridan aquifer as the source of Northeast Florida water supply; and

(5) list ways of conserving local water resources.

3.7 To demonstrate knowledge of shorelines students will:

(1) describe four ways that rock is weathered by sea waves; and

(2) explain the importance of sand dunes.

3.8 To demonstrate knowledge of historical geology, students will:

(1) explain the principle of superposition;

*(2) identify an index fossil as a guide to dating rock layers;

(3) describe the forms of life present during each geological era; and

(4) draw a geologic column.

4.0 Oceanography

4.1 Students will explain how measurements are made from moving ships and fixed locations.

4.2 To demonstrate knowledge of the physical properties of the ocean, students will:

*(1) identify the continental shelf, continental slope, ocean floor, mid-oceanic ridge, and trench when given a diagram of the ocean floor;

(2) discuss the different kinds of sediment present;

+(3) demonstrate the relationship between particle size and the rate of settling using laboratory equipment; and

(4) explain the relationship between temperature and depth.

4.3 To demonstrate knowledge of the chemical properties of the ocean, students will:

*(1) identify a definition of salinity;

+(2) construct a hydrometer; and

(3) discuss the relationship between temperature and the amount of dissolved gases.

4.4 Students will identify food, alternative energy sources, and mineral resources as economic benefits of the ocean.

4.5 To demonstrate knowledge of ocean movements, students will:

(1) describe the patterns of circulation near the sea surface;

+(2) produce density currents using appropriate equipment;

(3) discuss ways that energy is added to the sea to produce waves;

*(4) identify the average time difference between high tide and the next low tide;

*(5) identify erosion as a result of wave action on Jacksonville Beach; and

+(6) determine if the rate of heating is the same at all depths of water using laboratory equipment.

5.0 Meteorology

5.1 To demonstrate knowledge of the atmosphere, students will:

*(1) identify nitrogen and oxygen as the two most abundant gases in the atmosphere;

(2) explain the processes which maintain the chemical balance; and

(3) explain the greenhouse effect.

5.2 To demonstrate knowledge of wind, students will:

*(1) identify a definition of convection;

+(2) identify examples of heat transferral by conduction, convection, and radiation using appropriate laboratory equipment;

(3) discuss the Coriolis effect; and

*(4) identify polar easterlies, prevailing westerlies, trade wind, and doldrums when given a diagram indicating wind direction by the use of arrows.

5.3 To demonstrate knowledge of moisture, students will:

*(1) identify a definition of relative humidity;

+(2) measure relative humidity by using a psychrometer;

+(3) determine dew point by using appropriate laboratory equipment;

*(4) identify dew, frost, clouds, and fog as forms of condensation;

(5) discuss the causes and types of precipitation; and

(6) identify the instrument used to measure precipitation.

5.4 To demonstrate knowledge of weather change, students will:

(1) describe the origin of air masses;

(2) name the air masses that influence North American weather;

*(3) identify a definition of front; and

(4) discuss conditions which accompany a warm and cold front.

5.5 To demonstrate knowledge of weather forecasting, students will:

*(1) identify the functions of instruments used to observe weather: thermometer, barometer, anemometer, radiosonde, and radar;

(2) explain the information on a weather map; and

(3) explain how forecasts are made.

5.6 To demonstrate knowledge of local weather, students will:

(1) explain the conditions necessary for the formation of land and sea breezes; and

*(2) identify precautions to be taken during a hurricane and a tornado.

5.7 To demonstrate knowledge of climate, students will:

*(1) identify a definition of climate;

(2) explain how temperature, moisture, and air movement control climate; and

(3) describe several climates found in each of the three main climatic zones.

6.0 Earth Measurements

6.1 To demonstrate knowledge of the shape and size of the earth, students will:

(1) cite evidence that the earth is a sphere; and

(2) explain how directions and locations are determined.

6.2 To demonstrate knowledge of maps, students will:

(1) explain how map projections are made;

(2) list some of the uses; and

(3) explain how a scale is determined.

6.3 To demonstrate knowledge of topographic maps, students will:

(1) explain how contour lines are drawn;

(2) determine the contour interval when given a map;

(3) identify symbols commonly used;

(4) determine the elevation of specific points when given a map;

(5) determine the direction of flow of a stream when given a map; and

(6) locate a point by the township and range method.

KEY TO RECOMMENDED INSTRUCTIONAL MATERIALS

Performance Objective		Instructional Implications		Resources	
Number	Topic	Teaching Time	Tested on	County Adopted	Supplementary
1.0	Research Skills	2 weeks	MLST	W. L. Ramsey, et al, Modern Earth Science (New York: Holt, Rinehart, and Winston, Inc., 1979), p. 549.	F. M. Brown, et al, Earth Science (Morristown, N.J.: Silver Burdett, 1973), p. 10. M. S. Bishop, Focus On Earth Science (Columbus, Ohio: Merrill Publishing Co., 1976), pp. 31-32, Appendix A, B. W. L. Ramsey, et al, Holt Earth Science (New York: Holt, Rinehart and Winston, Inc., 1978), Chapter 1. S. N. Namowitz, Earth Science: The World We Live In (New York: American Book Company, 1975).
2.0	Astronomy	6 weeks	MLST	Ramsey, pp. 2-113.	Brown, Chapters 10, 12, 13, 14, 15. Bishop, Unit 1. Namowitz, Chapters 33-43. Ramsey, Chapters 13-15.

KEY TO RECOMMENDED INSTRUCTIONAL MATERIALS

Performance Objective		Instructional Implications		Resources	
Number	Topic	Teaching Time	Tested on	County Adopted	Supplementary
3.0	Geology	11 weeks	MLST	Ramsey, pp. 116-313, 376-417.	Bishop, Chapters 1-4. Brown, Chapters 1-3, 5, 9, 16-18, 25-32, Appendix 1. R. Heller and J. Byrne, et al, Challenges To Science: Earth Science (New York: McGraw-Hill, 1979), Chapters 5-15. Namowitz, Chapters 1-5, 8-17, 23-25, 30-32. Ramsey, Chapters 1-8.
4.0	Oceanography	4 weeks	MLST	Ramsey, pp. 316-73.	Bishop, Chapters 3, 4. Brown, Chapters 22-25. Namowitz, Chapters 18-22. Ramsey, Chapters 11, 12.
5.0	Meteorology	6 weeks	MLST	Ramsey, pp. 420-501.	Bishop, Chapters 1, 2. Brown, Chapters 10, 12-15.

KEY TO RECOMMENDED INSTRUCTIONAL MATERIALS

Performance Objective		Instructional Implications		Resources	
Number	Topic	Teaching Time	Tested on	County Adopted	Supplementary
					Namowitz, Chapters 33-43.
					Ramsey, Chapters 9, 10.
6.0	Earth Measurement	4 weeks		Ramsey, pp. 116-37.	Ramsey, pp. 487-89.

County Adopted Text:

W. L. Ramsey, et al, Modern Earth Science (New York: Holt, Rinehart, and Winston, 1979).

KEY TO LABORATORY RESOURCES

Objective	Skill	County Adopted Text Pages	Other Resources
	Students will:		
+1.1.2	measure mass, length, and volume using appropriate laboratory equipment.	549-50	F. M. Brown, et al, Laboratory Investigations In Earth Science (Morristown, N.J.: Silver Burdett, 1973), pp. 1-4. P. H. Joslin, Laboratory Investigations: Matter, Life, and Energy (Chicago, Illinois: Rand McNally and Company, 1972), pp. 1-12. W. L. Ramsey, et al, Holt Earth Science (New York: Holt, Rinehart, and Winston, 1973), pp. 7-8, 10-12.
+1.1.3	determine density of a material using appropriate laboratory procedures.		Ramsey, pp. 10-12. M. S. Bishop, et al, Focus On Earth Science (Columbus, Ohio: Merrill Publishing Co., 1976), pp. 31-32.
+1.2.5	use laboratory procedures to develop hypotheses and to identify controls.		Teacher originated activities.

KEY TO LABORATORY RESOURCES

Objective	Skill	County Adopted Text Pages	Other Resources
	Students will:		
+2.1.2	observe astronomical bodies with a telescope.		Jacksonville Museum of Arts and Sciences, Axexander Brest Planetarium
+2.6.2	determine the diameter of the moon using appropriate laboratory equipment.	77	
+3.1.3	identify mineral samples using laboratory procedures.	163-69	Ramsey, pp. 146-47.
+3.1.5	use laboratory methods to classify rock samples as igneous, sedimentary, or metamorphic.		Brown, p. 111. S. N. Namowitz, Earth Science: The World We Live In (New York: American Book Co., 1975), pp. 48-49, 55-67.
+3.5.5	demonstrate physical and chemical weathering using laboratory procedures.		Ramsey, pp. 177, 182-83.
+4.2.3	demonstrate the relationship between particle size and the rate of settling using laboratory equipment.	328	

KEY TO LABORATORY RESOURCES

Objective	Skill	County Adopted Text Pages	Other Resources
	Students will:		
+4.3.2	construct a hydrometer.	340	
+4.5.2	produce density currents using appropriate equipment.	358	Ramsey, pp. 344-45.
+4.5.6	determine if the rate of heating is the same at all depths of water using appropriate laboratory equipment.	354	
+5.2.2	identify examples of heat transferral by conduction, convection, and radiation using appropriate laboratory equipment.	433-34	Ramsey, pp. 258-59.
+5.3.2	measure relative humidity by using a psychrometer.		Ramsey, pp. 267-68, 271-73.
+5.3.3	determine dew point by using appropriate laboratory equipment.	442-43	Ramsey, pp. 280-81.

INTRODUCTION
MARINE BIOLOGY I

State Accreditator Number. . 1367
Course Code Number 2320
F.T.E. Category. 1.10
Instructional Level. . . . . Standard

Report Card Abbreviation . . Marine Bio 1
Length of Course . . . . . Year
Credit . . . . . 1 Science credit
Grade Level. 10, 11, 12

Prerequisites

Biology I

Textbook(s)

Reseck, John Jr., Marine Biology (Reston, Virginia: Reston Publishing Company, Inc., 1979).

Notes to Teachers

Full objectives in addition to Minimum Level Skills objectives are included in the Performance Objectives for Marine Biology. Students are to develop field and laboratory skills as well as content knowledge. Objective 2.0 will be taught at various times during the year as trips and labs are scheduled.

The Minimum Level Skills (MLS) objectives are indicated with an asterisk (*), and will be the only objectives tested on the Minimum Level Skills Test (MLST). The "Teaching Time" listed on the "Key to Instructional Materials" is a suggested maximum for each objective to help insure that all MLS objectives can be met by MLST time.

Laboratory skills are indicated with a plus sign (+). Suggested resources for teaching the laboratory skills have been listed at the end of this section of the teacher's guide. Other resources may be substituted for or added to the suggested laboratory resources.

MARINE BIOLOGY I

1.0 Oceanography

- 1.1 Chemical/Physical Properties of Sea Water
  - *1.1.1 Definitions: salinity, pH, dissolved oxygen, density, pressure, turbidity, temperature
  - *1.1.2 Instruments
  - +1.1.3 Measurement
  - 1.1.4 Interaction
- 1.2 Physical Aspects
  - *1.2.1 Tides/Waves
  - 1.2.2 Local current movements
  - 1.2.3 World-wide circulation patterns
  - *1.2.4 Upwelling
- 1.3 Geological Aspects
  - *1.3.1 Bottom features
  - 1.3.2 Echo soundings
  - 1.3.3 Marine sediments
  - +1.3.4 Cross profile
- 1.4 Man's Use/Misuse of Sea
  - 1.4.1 Recreational
  - 1.4.2 Commercial
  - *1.4.3 Commercial fishing problems
  - 1.4.4 Industrial

2.0 Marine Ecology

- 2.1 Food Chain Components
  - 2.1.1 Definitions: autotroph, heterotroph, myxotroph
  - 2.1.2 Food pyramid
  - *2.1.3 Trophic levels
- 2.2 Marine Zonation
  - 2.2.1 Shorelines
  - 2.2.2 Pelagic
  - 2.2.3 Benthic
- 2.3 Marine Ecosystems/Diversity
  - 2.3.1 Arctic/Antarctic
  - 2.3.2 Tropical
  - 2.3.3 North American
- 2.4 Marine Collection
  - *2.4.1 Equipment
  - *2.4.2 Organism identification
  - +2.4.3 Field care/Usage
- 2.5 Marine Aquaria
  - 2.5.1 Preparation
  - +2.5.2 Maintenance/ Observation
- 2.6 Laboratory Techniques
- 2.7 Taxonomy
  - 2.7.1 Binomial nomenclature
  - +2.7.2 Classification keys
  - 2.7.3 Classification basis
  - +2.7.4 Classification levels
- +2.8 Field Collection

3.0 Marine Algae

- 3.1 Characteristics
  - *3.1.1 Anatomy/Definitions
  - 3.1.2 Physiology
  - *3.1.3 Classification
  - *3.1.4 Pigmentation
  - *3.1.5 Uses
- 3.2 Chlorophytes
  - *3.2.1 Local forms identification
  - 3.2.2 Distribution
- 3.3 Phaeophytes
  - *3.3.1 Sargassum
  - 3.3.2 Origin/Community
- *3.4 Chrysophytes
  - 3.4.1 Diatoms
  - 3.4.2 Anatomy/Definitions
- 3.5 Rhodophytes
- +3.6 Algae Identification

* Indicates Minimum Level Skills
\+ Indicates Laboratory Skills

MARINE BIOLOGY I

4.0 Higher Marine Plants/Communities

- 4.1 Salt Marsh Communities
  - *4.1.1 Characteristics
  - *4.1.2 Spartina: identification
  - 4.1.3 Adaptations
  - 4.1.4 Zonation/Elevation
  - *4.1.5 Importance
- 4.2 Beach Communities
  - *4.2.1 Characteristics
  - *4.2.2 Sea oats: identification
  - 4.2.3 Adaptations
  - 4.2.4 Pioneer plants
  - 4.2.5 Dune formation/ Maritime forest
  - *4.2.6 Importance
- 4.3 Mangrove Marsh Communities
  - 4.3.1 Geographic location
  - 4.3.2 Mangrove tree: identification
  - 4.3.3 Types/Adaptations
  - 4.3.4 Importance
- +4.4 Profiles: Salt Marsh/ Beach

5.0 Plankton/Protozoans

- 5.1 Definitions: Zooplankton/ Phytoplankton/Meroplankton/ Holoplankton
- *5.2 Zooplankton/Phytoplankton: Identification
- *5.3 Meroplankton/Holoplankton: Identification
- +5.4 Plankton Identification
- 5.5 Plankton Skeletal Accumulations
- *5.6 Red Tide
- *5.7 Copepod Identification
- *5.8 Arrow worms
  - 5.8.1 Predator
  - 5.8.2 Indicator
- 5.9 Phylogenetic Representation
- 5.10 Protozoans
  - 5.10.1 Characteristics
  - 5.10.2 Classification
  - 5.10.3 Anatomy/Physiology
  - 5.10.4 Bioluminescence
  - 5.10.5 Indicators/ Geological time

6.0 Poriferans

- *6.1 Characteristics
- 6.2 Classification
  - 6.2.1 Canal systems
  - *6.2.2 Composition
- *6.3 Anatomy
- *6.4 Physiology
- 6.5 Habit/Habitat
- 6.6 Symbiotic Relationships

7.0 Coelenterates/Ctenophores

- *7.1 Characteristics: Coelenterates
- 7.2 Classification
  - 7.2.1 Hydrozoan
  - 7.2.2 Scyphozoan
  - 7.2.3 Anthozoan
- +7.3 Identification: Coelenterates
- 7.4 Hydrozoan/Scyphozoan
  - *7.4.1 Polymorphism
  - *7.4.2 Body forms
  - 7.4.3 Life cycles: Obelia, Aurelia
- *7.5 Aurelia Anatomy
- 7,6 Anthozoan
  - *7.6.1 Sea anemone anatomy
  - *7.6.2 Definition: coral
  - 7.6.3 Reef: formation, distribution
  - 7.6.4 Coral reef types
  - 7.6.5 Coral differentiation: hard, soft
- *7.7 Characteristics: Ctenophores
- 7.8 Anatomy: Ctenophores

MARINE BIOLOGY I

8.0 Mollusks

- *8.1 Definition
- *8.2 Identification: Gastropod/Pelecypod/Cephalopod
- 8.3 Shell
  - 8.3.1 Mantle secretion
  - 8.3.2 Diversity
  - 8.3.3 Size/Visceral mass
- 8.4 Gastropods
  - *8.4.1 Definitions: radula, torsion, peristalsis, operculum
  - *8.4.2 Shell anatomy
  - 8.4.3 Locomotion
  - 8.4.4 Slug/Nudibranch
  - 8.4.5 Feeding habits
  - 8.4.6 Reproduction
- 8.5 Pelecypods
  - *8.5.1 External clam anatomy
  - *8.5.2 Internal clam anatomy
  - 8.5.3 Feeding habits
  - 8.5.4 Shipworms/Economic importance
  - 8.5.5 Mariculture
  - +8.5.6 Clam dissection
- 8.6 Cephalopods

9.0 Arthropods

- *9.1 Characteristics
- 9.2 Crustaceans
  - 9.2.1 Crustacean identification
  - *9.2.2 Decapod definition
  - *9.2.3 Crab anatomy
  - *9.2.4 Anatomical functions
  - 9.2.5 Physiology
  - *9.2.6 Economically important decapods
  - +9.2.7 Crab dissection
- 9.3 Other Marine Arthropods
  - 9.3.1 Identification
  - 9.3.2 Anatomy horseshoe crab
  - 9.3.3 Habits/Habitats
- 9.4 Comparison: Copepod/Barnacle/Crab

10.0 Echinoderms

- *10.1 Characteristics
- *10.2 Water Vascular System
  - 10.2.1 Components
  - 10.2.2 Function
- +10.3 Identification
- *10.4 Sea Star Anatomy
- 10.5 Anatomy: Sea Lily/Brittle Star/Sea Urchin/Sand Dollar/Sea Cucumber
- *10.6 Definitions: Pedicellaria/Papula/Aristotle's Lantern/Test/Respiratory Tree/Evisceration/Lunules/Shields
- 10.7 Habits/Habitats
- +10.8 Anatomy: Sea Star
- +10.9 Observation: Sea Star

11.0 Chordates

- 11.1 Characteristics
- 11.2 Classification: Urochordates/Agnathans/Chondrichthyes/Osteichthyes/Reptiles/Birds/Mammals
- 11.3 Anatomy
- 11.4 Physiology Comparison
- 11.5 Habits/Habitats
- +11.6 Classification: Specimens
- +11.7 Dissection: Bony Fish/Shark

PERFORMANCE OBJECTIVES
MARINE BIOLOGY I

To demonstrate the ability to recall and apply knowledge of oceanography, marine ecology, marine algae, higher marine plants, plankton, Protozoans, Poriferans, Coelenterates, Ctenophores, Mollusks, Arthropods, Echinoderms, and Chordates, students will master the performance objectives listed below. Successful completion of this course is based on teacher judgment and the requirement that students pass the Minimum Level Skills Test.

Performance Objectives

1.0 Oceanography

1.1 To demonstrate knowledge of the chemical and physical properties of sea water, students will:

*(1) identify a definition of salinity, pH, dissolved oxygen, density, pressure, turbidity, or temperature;

*(2) identify the instruments that measure salinity, pH, density, turbidity, or temperature, when given a diagram;

+(3) measure salinity, pH, dissolved oxygen, density, turbidity, or temperature of sea water samples; and

(4) discuss the interaction of the above properties.

1.2 To demonstrate knowledge of physical oceanography, students will:

*(1) identify a definition of tides, tidal range, waves, or currents;

(2) compare local current movements and their effects on beaches and marine organisms;

(3) identify the factors which cause world-wide circulation; and

*(4) identify the causes and effects of upwelling.

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* Indicates Minimum Level Skills
\+ Indicates Laboratory Skills

1.3 To demonstrate knowledge of geological oceanography, students will:

*(1) identify continental shelf, continental slope, trench, abyssal plain, mid-ocean ridge, or island when given a cross-section profile diagram;

(2) explain how echo soundings are used to map the ocean floor;

(3) distinguish between terrigenous and pelagic sediments; and

+(4) construct a cross-section profile using the depths at various points across the ocean floor.

1.4 To demonstrate knowledge of man's use and misuse of the sea, students will:

(1) identify diving, swimming, fishing, surfing, and boating as recreational uses;

(2) explain transportation, sea farming, oil exploration, and undersea mining as commercial uses;

*(3) identify the problems encountered in commercial fishing, such as overfishing, fishing the nursery grounds, pollution, dredging and filling, lack of diversity in national taste, antiquated equipment, or non-scientific fishing methods; and

(4) critique the use of sea water by industry, e.g., dumping, cooling, electricity, and fresh water source.

2.0 Marine Ecology

2.1 To demonstrate knowledge of food chain components, students will:

(1) identify a definition of autotroph, heterotroph, and myxotroph;

(2) describe the inverse ratio of fish size to fish population as illustrated by a food pyramid; and

*(3) identify trophic levels as producer, consumer, or reducer when given examples of marine food chain.

2.2 To demonstrate knowledge of marine zonation, students will:

(1) categorize shorelines according to their locations (dune, beach, estuary, marsh); substrate type (sand, rock, mud, man-made); and tidal zones (spray, high, tidal pool, low, sublittoral);

(2) define pelagic zones; and

(3) divide benthic zones.

2.3 To demonstrate knowledge of diversity in marine ecosystems, students will compare major biotic and abiotic conditions of the following:

(1) Arctic/Antarctic environments;

(2) tropical environments (corals/mangroves); and

(3) North American environments (Atlantic/Pacific).

2.4 To demonstrate knowledge of marine collection, students will:

*(1) identify the plankton net, beach seine, screen box, cast net, or dip net as marine collection equipment when given a diagram;

*(2) identify by common name the organisms caught by a plankton net, beach seine, screen box, cast net, or dip net, when given a diagram; and

+(3) demonstrate field care and usage of equipment.

2.5 To demonstrate knowledge of marine aquaria, students will:

(1) outline the correct sequence of procedures for establishing a marine aquarium in the classroom; and

+(2) maintain and observe a classroom aquarium to record and chart changing abiotic conditions.

2.6 Students will list proper laboratory procedures and techniques.

2.7 To demonstrate knowledge of taxonomy, students will:

(1) identify an advantage of using binomial nomenclature instead of common names for classification;

+(2) demonstrate the use of a classification key when given a set of marine organisms;

(3) identify anatomy, physiology, and embryology as bases for classification; and

+(4) match characteristics of marine organisms with their corresponding classification levels of kingdom, phyla, and class when given representative specimens.

+2.8 Students will operate marine collection equipment in the field to demonstrate care of live field specimens.

3.0 Marine Algae

3.1 To demonstrate knowledge of the general characteristics of marine algae, students will:

*(1) define the thallus, stripe, pneumatocyst, or holdfast;

(2) identify the functions of the characteristics;

*(3) identify that algae are classified by color;

*(4) identify the presence of green chlorophyll in green, brown, golden-brown, and red algae; and

*(5) identify uses of marine algae as being a food source, insulation in bricks, thickeners, abrasives, or the basic ingredient in agar.

3.2 To demonstrate knowledge of the chlorophytes, students will:

*(1) identify Ulva, Enteromorpha, Cladophora, or Codium as local examples of green algae when given a list of algae; and

(2) state the distribution and effect of pollution on the growth of green algae.

3.3 To demonstrate knowledge of Phaeophytes, students will:

*(1) identify Sargassum as the local example of brown algae when given a list of algae; and

(2) discuss the origin of the sargassum algae and the community found therein.

*3.4 To demonstrate knowledge of chrysophytes students will:

(1) identify diatoms as local examples of golden-brown algae when given a list of algae; and

(2) define epitheca, hypotheca, frustule, girdle, or chloroplast.

3.5 Students will identify rhodophytes as red algae.

+3.6 Students will identify examples of various local algae.

4.0 Higher Marine Plants/Communities

4.1 To demonstrate knowledge of salt marsh communities, students will:

*(1) identify wide range of salinity, tidal fluctuations, nutrient trap, or turbid water as characteristics of the salt marsh;

*(2) identify Spartina as the important salt marsh plant;

(3) discuss the adaptations of Spartina to the marine environment;

(4) discuss the relationship between plant zonation and changes in elevation in the salt marsh; and

*(5) identify the importance of salt marshes as the nursery grounds for marine life.

4.2 To demonstrate knowledge of the beach communities, students will:

*(1) identify shifting substrate, salt spray, extreme temperature ranges, unfertile soil, dry, and arid conditions as characteristics of the beach and dunes;

*(2) identify the sea oat as the beach plant that prevents erosion or begins dune formation;

(3) discuss the adaptations of the sea oat to the dune environment;

(4) list the other pioneer plants that aid in dune formation;

(5) discuss how dune formation leads to the formation of maritime forest; and

*(6) identify the importance of dunes for protection of inshore property.

4.3 To demonstrate knowledge of mangrove marsh communities, students will:

(1) compare the geographic location of mangrove marshes to salt marshes;

(2) identify the mangrove tree as the important plant present in the community;

(3) identify four types of mangroves (red, black, white, Buttonwood) and their adaptations to the marine environment; and

(4) discuss the importance of the mangrove and mangrove marshes.

+4.4 Students will construct profiles of the salt marsh and the beach.

5.0 Plankton/Protozoans

5.1 Students will define zooplankton, phytoplankton, meroplankton, and holoplankton.

*5.2 Students will identify examples of zooplankton or phytoplankton when given a drawing.

*5.3 Students will identify examples of meroplankton or holoplankton when given a drawing.

+5.4 Students will identify examples of local plankton using an identification manual.

5.5 Students will identify foraminiferans, radiolarians, or diatoms as plankton forms whose skeletons accumulate on the ocean floor.

*5.6 Students will identify the causes and effects of the red tide.

*5.7 Students will identify the copepod when given a drawing.

*5.8 To demonstrate knowledge of arrow worms, students will:

(1) identify arrow worms as predators of smaller zooplankton; and

(2) identify arrow worms as indicator organisms for certain oceanic conditions.

5.9 Students will state that members of all phyla are present in plankton.

5.10 To demonstrate knowledge of protozoans, students will:

(1) identify protozoans as microscopic, one-celled animals;

(2) classify protozoans as ciliate, rhizopod, or flagellate;

(3) compare the anatomy and physiology of the ciliates, rhizopods, and flagellates;

(4) explain the phenomenon of marine bioluminescence; and

(5) state that the fossil skeletons of certain foraminiferans are geological time indicators.

6.0 Poriferans

*6.1 Students will identify the primary characteristic of sponges as being bodies perforated by pores and canals.

6.2 To demonstrate knowledge of the classification of poriferans, students will:

(1) classify sponges according to their canal systems (leucon, syncon, ascon); and

*(2) identify the skeletal composition as either spicules or spongin, or both.

*6.3 Students will label choanocytes, skeletal spicules, amoebocytes, porocytes, osculum, or epidermal cells on a diagram.

*6.4 Students will give the functions of each of the above structures.

6.5 Students will identify adult sponges as sessile, benthic animals.

6.6 Students will describe various symbiotic relationships of sponges.

7.0 Coelenterates/Ctenophores

*7.1 Students will identify nematocysts as the characteristic of coelenterates.

7.2 To demonstrate knowledge of coelenterate classification, when given a list students will:

(1) identify hydrozoans as Obelia, Tubularia, or man-of-war;

(2) identify scyphozoans as the true jellyfish; and

(3) identify anthozoans as sea anemone, coral, or sea fan.

+7.3 Students will classify common coelenterates specimens as hydrozoans, scyphozoans, or anthozoans.

7.4 To demonstrate knowledge of hydrozoans and scyphozoans, students will:

*(1) identify the definition of polymorphism;

*(2) identify the body forms as polyp or medusa; and

(3) examine the life cycles of Obelia and Aurelia.

*7.5 Students will identify the gonads, oral arms, mouth, or tentacle when given a diagram of Aurelia.

7.6 To demonstrate knowledge of anthozoans, students will:

*(1) identify the mouth, tenacles, gullet, gastrovascular cavity, or pedal disk when given a diagram of a sea anemone;

*(2) define a coral as a colony of small polyps that live on or in a calcium carbonate skeleton;

(3) discuss the formation and geographic distribution of the coral reef;

(4) identify the three types of coral reefs (fringing, barrier, and atoll); and

(5) discuss the difference between hard and soft corals.

*7.7 Students will identify comb-plates as characteristics of ctenophores.

7.8 Students will label the anatomical features of a ctenophore when given a diagram.

8.0 Mollusks

*8.1 Students will define Mollusks as soft-bodied animals, usually with a shell and muscular foot.

*8.2 Students will differentiate between gastropod, pelecypod, or cephalopod when given drawings of all forms.

8.3 To demonstrate knowledge of the shell, students will:

(1) state that the shell is secreted by mantle;

(2) discuss diversity of shell formation; and

(3) discuss increase in size as related to visceral mass.

8.4 To demonstrate knowledge of gastropods, students will:

*(1) define radula, torsion, peristalsis, or operculum;

*(2) identify apex, columella, aperture, body whorl, or spire as external features of a gastropod shell when given a drawing;

(3) discuss the locomotion of a gastropod;

(4) state that nudibranchs and sea slugs lack an external shell;

(5) discuss the diversity of feeding habits in gastropods; and

(6) discuss reproduction of gastropods.

8.5 To demonstrate knowledge of pelecypods students will:

*(1) identify the hinge, umbo, beak, hinge tooth, muscle scars, or pallial line when given a drawing of a clam shell;

*(2) identify the heart, liver, intestine, gonad, muscle, foot, mantle, gill, or kidney when given a drawing of a clam;

(3) discuss feeding habits of pelecypods;

(4) discuss the economic importance of shipworms;

(5) discuss mariculture of clams, oysters, and mussels; and

+(6) observe the external and internal anatomy of a clam.

8.6 Students will discuss the modification of the foot, jet propulsion, eye, survival techniques, feeding habits, and reproduction in the cephalopods.

9.0 Arthropods

*9.1 Students will identify jointed appendages, segmented body, carapace, molting, regeneration, and autonomy as characteristics of the crustacean.

9.2 To demonstrate knowledge of crustaceans, students will:

(1) identify the marine crustaceans when given a list of common names;

*(2) define a decapod;

*(3) label carapace, cheliped, walking leg, swimming leg, abdomen, antenna, antennules, maxillapeds, or branchial area when given a diagram of a crab;

*(4) state the functions of the anatomical features listed above;

(5) identify and discuss the physiology of the crab;

*(6) identify the blue crab, stone crab, king crab, shrimp, or lobster as economically important decapods; and

+(7) observe the external and internal anatomy of a crab.

9.3 To demonstrate knowledge of other marine arthropods, students will:

(1) identify the horseshoe crab, sea spiders, or insects as examples of marine arthropods;

(2) label the external anatomy of the horseshoe crab; and

(3) compare the habits and habitats of the marine arthropods listed above.

9.4 Students will compare the habitats, carapace, appendages, respiration, and feeding methods of a copepod, barnacle, and crab.

10.0 Echinoderms

*10.1 Students will identify water vascular system, calcareous ossicles, spiny or leather-like skin, or tube feet in most forms as characteristics of the echinoderms.

*10.2 To demonstrate knowledge of the water vascular system, students will:

(1) identify madreporite, stone canal, ring canal, radial canal, ampulla, or tube foot when given a diagram; and

(2) identify the function of the entire system as locomotion.

+10.3 Students will identify the echinoderms when given preserved specimens.

*10.4 Students will identify the pedicellaria, papula, madreporite, spine, tube feet, stomach, pyloric caeca, gonads, radial canal, or ampulla when given a drawing of a sea star.

10.5 Students will label the anatomical features of the sea lily, brittle star, sea urchin, sand dollar, and sea cucumber when given a drawing of each animal.

*10.6 Students will define pedicellaria, papula, Aristotle's Lantern, test, respiratory tree, evisceration, lunules, and shields.

10.7 Students will identify the habits and habitats of the echinoderms.

+10.8 Students will observe the external and internal anatomy of a sea star.

+10.9 Students will record the habits of a live sea star after observation.

11.0 Chordates

11.1 Students will identify chordates as having a notochord, dorsal nerve cord, and gill slits.

11.2 Students will classify marine chordates as Urochordates, Agnathans, Chondryichthyes, Osteichthyes, Reptiles, Birds, or Mammals.

11.3 On a diagram, students will label the external anatomy of an amphioxus, lamprey, dogfish shark, and perch.

11.4 Students will compare shark, marine fish, and marine mammal physiology.

11.5 Students will compare habits and habitats of sharks, fish, marine birds, reptiles, and marine mammals.

+11.6 Students will classify marine chordates when given preserved specimens.

+11.7 Students will dissect the bony fish and the dogfish shark to compare external features and major organs of locomotion, feeding, and flotation.

KEY TO RECOMMENDED INSTRUCTIONAL MATERIALS

Performance Objective		Instructional Implications		Resources	
Number	Topic	Teaching Time	Tested on	County Adopted	Supplementary
1.0	Oceanography	3 weeks	MLST	John Reseck Jr., Marine Biology (Reston, Virginia: Reston Publishing Co., Inc., 1979), pp. 17-35, 47-60.	Tracy I. Storer, et al, General Zoology (New York: McGraw-Hill Book Co., 1979), pp. 264-97. Neil W. Crenshaw, Marine Biology-A Systematic Approach (Duval County School Board Science Office, 1978), pp. 1-12. Robert Zottoli, Introduction To Marine Environments (St. Louis: C. V. Mosby Co., 1973), pp. 9-25.
2.0	Marine Ecology	3 weeks	MLST	Reseck, pp. 36-45, 64-76, 86-121, 125-30.	Marine Science Education Center Teachers The Sourcebook of Marine Sciences (Tallahassee, Florida: Department of Education, 1980), pp. 1-2. Jeff Hallett, A Simple Marine Aquarium (MSEC).

KEY TO RECOMMENDED INSTRUCTIONAL MATERIALS

Performance Objective		Instructional Implications		Resources	
Number	Topic	Teaching Time	Tested on	County Adopted	Supplementary
					Robert D. Burns and Karl A. Stiles, Laboratory Explorations in General Zoology (New York: MacMillan Publishing Co., Inc., 1977), pp. 343-64, 377-78. Crenshaw, pp. 37-56.
3.0	Marine Algae	2 weeks	MLST		Robert Barnes, Invertebrate Zoology (Philadelphia: W. B. Saunders, 1974), pp. 702-03. Bayard H. McConnaughey, Introduction to Marine Biology (St. Louis: C. V. Mosby Co., 1974), pp. 74-95. Crenshaw, pp. 23-40.
4.0	Higher Marine Plants/ Communities	2 weeks	MLST	Reseck, pp. 77-85.	Crenshaw, pp. 57-69. Sourcebook of Marine Science, pp. 19-24, 3-10.

KEY TO RECOMMENDED INSTRUCTIONAL MATERIALS

Performance Objective		Instructional Implications		Resources	
Number	Topic	Teaching Time	Tested on	County Adopted	Supplementary
5.0	Plankton/ Protozoans	3 weeks	MLST	Reseck, pp. 131-37.	Patricia Kirkland, Plankton of the St. John's River (MSEC). Barnes, pp. 8-59, 821-24.
6.0	Poriferans	1 week	MLST	Reseck, pp. 139-42.	Crenshaw, pp. 70-75. Barnes, pp. 73-86.
7.0	Coelenterates/ Ctenophores	3 weeks	MLST	Reseck, pp. 143-53.	Crenshaw, pp. 76-96. Storer, pp. 371-94. Barnes, pp. 88-136, 138-43.
8.0	Mollusks	5 weeks	MLST	Reseck, pp. 155-68.	Crenshaw, pp. 138-65. Storer, pp. 466-96. Barnes, pp. 317-431.
9.0	Arthropods	5 weeks	MLST	Reseck, pp. 169-93.	Crenshaw, pp. 166-215. Storer, pp. 518-62.

KEY TO RECOMMENDED INSTRUCTIONAL MATERIALS

Performance Objective		Instructional Implications		Resources	
Number	Topic	Teaching Time	Tested on	County Adopted	Supplementary
					Barnes, pp. 452-56, 505-08, 510-616.
10.0	Echinoderms	2 weeks	MLST	Reseck, pp. 184-96.	Crenshaw, pp. 222-49. Storer, pp. 610-30. Barnes, pp. 724-95.
11.0	Chordates	5 weeks	MLST	Reseck, pp. 208-39.	Crenshaw, pp. 250-66. Storer, pp. 631-808. McConnaughey, pp. 344-78.

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KEY TO LABORATORY RESOURCES

Objective	Skill	County Adopted Text Pages	Other Resources
	Students will:		
+1.1.3	measure salinity, pH, dissolved oxygen, density, turbidity, or temperature of sea water.		The Sourcebook of Marine Sciences (Tallahassee: Florida Department of Education, 1970), pp. 25-42. Robert Zottli, Introduction to Marine Environments (St. Louis: C. V. Mosby Co., 1973), pp. 23-25, 44-51, 88.
+1.3.4	construct cross-section profiles using the depths at various points.		Sourcebook of Marine Sciences, pp. T33-34.
+2.4.3	demonstrate field care and usage of marine collection equipment.		MSEC
+2.5.2	maintain and observe a healthy marine aquarium.		Sourcebook of Marine Sciences, pp. 1-8.
+2.7.2	demonstrate use of a classification key with marine specimens.		Robert D. Burns and Karl A. Stiles, Laboratory Explorations in General Zoology (New York: MacMillan Publishing Co., Inc., 1977), pp. 376-86.

KEY TO LABORATORY RESOURCES

Objective	Skill	County Adopted Text Pages	Other Resources
	Students will:		
+2.7.4	match characteristics of marine organisms with their corresponding classification levels of kingdom, phyla, and class when given representative specimens.		Patricia Kirkland, Identification Manual for Common Estuarine Invertebrates of the Little Jetties St. Johns River (MSEC, 1981).
+2.8	operate marine collection equipment in the field to demonstrate care of live field specimens.		MSEC
+3.6	identify examples of various local algae.		E. Yale Dawson, How to Know the Seaweeds (Dubuque, Iowa: William C. Brown Company, 1956). Bayard H. McConnaughey, Introduction to Marine Biology (St. Louis: C. V. Mosby Co., 1974), pp. 74-88. Zottoli, pp. 55-84. Alan Major, The Book of Seaweeds (London: Gordon & Cremones Press, 1977).

KEY TO LABORATORY RESOURCES

Objective	Skill	County Adopted Text Pages	Other Resources
	Students will:		
			Kenneth L. Gosner, A Field Guide to the Atlantic Seashore (Boston: Houghton Mifflin, Co., 1979), pp. 25-54.
+4.4	construct profiles of the salt marsh and the beach.		Sourcebook of Marine Science, pp. 19-24, 3-10.
+5.4	identify examples of local plankton.		Patricia Carothers Kirkland, Plankton ID Manual, (MSEC, 1973).
+7.3	identify coelenterate/ctenophore specimens.		Irwin & Vilia Sherman, The Invertebrates: Function & Form - A Laboratory Guide (New York: MacMillan Publishing Co., Inc., 1970), pp. 61, 66, 70, 71, 85-6.
+8.5.6	dissect a clam.		Burns & Stiles, pp. 209-16. Stephen G. Gilbert, Atlas of General Zoology (Seattle: University of Washington Press, 1965).
+9.2.7	dissect a crab.		Burns & Stiles, pp. 175-88.

KEY TO LABORATORY RESOURCES

Objective	Skill	County Adopted Text Pages	Other Resources
	Students will:		
+10.3	identify echinoderms when given preserved specimens.		Burns & Stiles, pp. 217-25. Barnes, p. 735
+10.8	dissect a sea star.		Burns & Stiles, pp. 217-25.
+10.9	observe live sea stars.		Burns & Stiles, pp. 217-25.
+11.6	classify marine chordates when given preserved specimens.		Burns & Stiles, pp. 217-25.
+11.7	dissect a bony fish and dogfish shark.		Laurence M. Ashley, Lab Anatomy of the Shark (Dubuque, Iowa: Wm. C. Brown Co., 1976). Stephen G. Gilbert, Pictoral Anatomy of the Dogfish (Seattle: University of Washington Press, 1973). Robert B. Chiasson, Lab Anatomy of the Perch (Dubuque, Iowa: William C. Brown Company, 1980). Burns & Stiles, pp. 233-39. Saul Wischnitzer, Atlas and Dissection Guide for Comparative Anatomy (San Francisco: W. H. Freeman and Co., 1972), pp. 21-72.

INTRODUCTION
MARINE BIOLOGY II

State Accreditator Number. . 1367
Course Code Number 2241
F.T.E. Category. 1.10
Instructional Level. . . . . Advanced

Report Card Abbreviation . . Marine Bio II
Length of Course . . . . . Year
Credit . . . . . 1 Science credit
Grade Level. 11, 12

Prerequisites

Marine Biology I

Textbook(s)

McConnaughey, B. H. Introduction to Marine Biology. Mosby, 1974.

Notes to Teachers

Full objectives are included in addition to the Minimum Level Skills objectives. Students are to develop laboratory and research skills as well as content knowledge.

The Minimum Level Skills (MLS) objectives are indicated with an asterisk (*), and will be the only objectives tested on the Minimum Level Skills Test (MLST). The "Teaching Time" listed on the Key to Instructional Materials is a suggested maximum for each objective to help insure that all MLS objectives can be met by Minimum Level Skills Test time.

Laboratory skills are indicated with a plus sign (+). Suggested resources for teaching the laboratory skills have been listed at the end of this section of the teacher's guide. Other resources may be substituted for or added to the suggested laboratory resources.

COURSE OUTLINE

MARINE BIOLOGY II

1.0 Research Skills

- 1.1 Scientific Research Method
  - 1.1.1 Hypothesis identification
  - 1.1.2 Materials
- 1.2 Data Organization
  - *1.2.1 Observations/ Assumptions
  - +1.2.2 Metric measurement skills
- *1.3 Bar/Line Graph Analysis
- *1.4 Valid Conclusions

2.0 Marine Chemistry

- 2.1 Water Chemistry
  - +2.1.1 pH
  - 2.1.2 Acid-base reaction
  - 2.1.3 Oxidation-reduction reaction
- *2.2 Nitrogen Cycle

3.0 Marine Ecology

- *3.1 Ecological Systems
  - 3.1.1 Energy flow
  - 3.1.2 Laws
  - 3.1.3 Productivity
- +3.2 Closed-system Ecosystem
- 3.3 Coastal Environments
  - *3.3.1 Shorelines
  - 3.3.2 Reef
  - *3.3.3 Bay/Estuary
  - 3.3.4 Intertidal
- 3.4 Oceanic Zones
- 3.5 Organism Distribution Factors
- +3.6 Sediments
  - 3.6.1 Particle composition
  - 3.6.2 Particle analysis
- 3.7 Specialized Biomes

4.0 Microscopic Marine Plankton Identification

- *4.1 Microscopic Plankton Divisions
- 4.2 Diatom/Dinoflagellate Anatomy
- *4.3 Diatom Classification
- 4.4 Zooplankton Anatomy
  - *4.4.1 Protozoa
  - *4.4.2 Coelenterata
  - *4.4.3 Echinodermata
  - 4.4.4 Chaetognatha
  - *4.4.5 Mollusca
  - *4.4.6 Annelida
  - *4.4.7 Arthropoda
  - 4.4.8 Chordata
  - 4.4.9 Minor phyla
- +4.5 Zooplankton Classification
- 4.6 Data Correlation
- +4.7 Index Components Identification
- +4.8 Counting Methods
- 4.9 Analysis of Results

5.0 Macroscopic Marine Plankton Identification

- 5.1 Macroscopic Plankton
  - *5.1.1 Divisions
  - +5.1.2 Scyphozoa/ Ctenophora
- 5.2 Scyphozoan Classification

6.0 Exploration of the Marine Environment

- 6.1 Underwater Physics
  - *6.1.1 Gas/Pressure laws
  - 6.1.2 Water: physical conditions

* Indicates Minimum Level Skills
\+ Indicates Laboratory Skills

MARINE BIOLOGY II

- 6.2 Underwater Physiology
  - *6.2.1 Circulatory system
  - *6.2.2 Respiratory system
  - 6.2.3 Interrelationships of systems
- 6.3 Medical Aspects
  - *6.3.1 Direct/Indirect effects of pressure
  - 6.3.2 Treatment
- 6.4 Diving Equipment/ Safety
  - 6.4.1 Basic equipment
  - 6.4.2 SCUBA
  - 6.4.3 Commercial diving
  - *6.4.4 Ascent rate
  - 6.4.5 Decompression tables

+7.0 Marine Vertebrate Dissection

- *7.1 External Features/ Functions
- *7.2 Digestive/Urogenital System
- 7.3 Respiratory/ Circulatory System
- *7.4 Nervous System
- *7.5 Skeletal System
- 7.6 Muscular System

+8.0 Macroscopic Marine Phyla

- 8.1 Identification Skills
  - 8.1.1 Specimen collection
  - 8.1.2 Classification/ Categorization
  - 8.1.3 Identification key
  - 8.1.4 Application
- 8.2 Specimen Preservation

9.0 Population Studies: Lincoln Index

- 9.1 Lincoln Index Usage
- +9.2 Application

10.0 Salinity Tolerance: Euryhaline Organisms

- 10.1 Salinity Tolerance Laboratory Skills
  - +10.1.1 Apparatus set up
  - +10.1.2 Organism observations
  - 10.1.3 Analysis of results
  - +10.1.4 Experiment reversal
  - 10.1.5 Analysis of results
- 10.2 Correlation

PERFORMANCE OBJECTIVES
MARINE BIOLOGY II

To demonstrate ability to recall and apply knowledge of research skills, marine chemistry, marine ecology, microscopic marine plankton, macroscopic marine plankton, exploration of marine environment, marine vertebrate dissection, macroscopic marine specimens, Lincoln Index and salinity tolerance, students will master the performance objectives listed below. Successful completion of this course is based on teacher judgement and the requirement that students pass the MLST.

Performance Objectives

1.0 Research Skills

1.1 To demonstrate knowledge of scientific research methods, students will:

*(1) identify a statement as being hypothetical; and

(2) list the materials necessary to perform a given experiment.

1.2 To demonstrate knowledge of data organization, students will:

*(1) identify statements as observations or assumptions; and

+(2) gather data using standard laboratory and field equipment.

*1.3 To demonstrate knowledge of graph analysis, students will analyze bar and line graphs containing laboratory or field data.

*1.4 To demonstrate knowledge of scientific research methods, students will select valid conclusions when given laboratory data.

2.0 Marine Chemistry

2.1 To demonstrate knowledge of water chemistry, students will:

+(1) measure the pH of a liquid using standard laboratory procedures;

* Indicates Minimum Level Skills
\+ Indicates Laboratory Skills

*(2) identify an acid-base reaction when given an equation; and

*(3) identify an oxidation-reduction reaction when given an equation.

*2.2 To demonstrate knowledge of the nitrogen cycle, students will identify the cycle as the primary source of nutrients for the marine plants and that the primary waste product of marine organisms is ammonia.

3.0 Marine Ecology

*3.1 To apply knowledge of ecological systems, students will:

(1) identify the energy flow of a marine ecosystem as consisting of the amount of energy from the sun, how much the living organisms utilize this energy and how the nutrients are recycled and lost;

(2) identify an example of Leibig's Law of the Minimum and Shelford's Law of Tolerance; and

(3) identify that the productivity of an ecosystem is determined by the limiting factors present in the ecosystem.

+3.2 To demonstrate marine biology laboratory skills, students will set up and maintain a closed-system ecosystem.

3.3 To demonstrate knowledge of coastal environments, students will:

*(1) identify the physical characteristics of rocky, muddy, or sandy shorelines;

(2) relate, in writing, the physical characteristics of the coral reef to the biota present on a reef;

*(3) identify the three factors that affect the productivity of bays and estuaries as nutrient trap, year around photosynthesis and wide salinity ranges; and

(4) describe the subdivisions of the intertidal zone as related to the physical and biological factors present in the zone.

3.4 To demonstrate knowledge of oceanic zones, students will relate the physical characteristics of the oceanic zones to the distribution of life forms.

3.5 To demonstrate knowledge of abiotic and biotic factors, students will relate these factors to vertical circulation, oxygen minimum layer, and compensation depth.

+3.6 To demonstrate knowledge of sediments, students will:

(1) identify the composition of the sediment particles; and

(2) classify given samples of sediments as to their size, shape, weight, composition, mineral content, and porosity.

3.7 To demonstrate knowledge of biome formation, students will relate particle sizing to the formation of specialized biomes such as the anaerobic biome and RPD layer.

4.0 Microscopic Marine Plankton Identification

*4.1 To demonstrate knowledge of plankton identification, students will identify the divisions of plankton as being phytoplankton, zooplankton, meroplankton, holoplankton, ultraplankton, and nanoplankton from descriptions.

4.2 To demonstrate knowledge of diatom and dinoflagellate anatomy, students will identify selected parts of diatom and dinoflagellate anatomy from diagrams.

*4.3 To demonstrate knowledge of diatom classification, students will classify diatoms according to presence of a raphe, shape, flotation device, size, motility, distribution of chromatophores, and habitat.

4.4 To demonstrate knowledge of the anatomy of zooplankton students will:

*(1) identify the size, shell composition, form, and the presence of projections in the protozoans;

*(2) identify the planula and ephyra larval forms, size, and motility in the coelenterates;

*(3) identify the larval forms in the echinoderms;

(4) identify the external and internal anatomy in the chaetognaths;

*(5) identify the presence of and type of shell, velum, and larval forms in the molluscans;

*(6) identify trophophore larva and presence of ciliated bands in the annelids;

*(7) identify the nauplii larva, types of copepods, zoea, and megalops in the arthropods;

(8) identify the free-swimming larva of the tunicate as being tadpole-shaped; and

(9) identify juvenile forms of bryozoans, phoronidians as being members of the minor phyla found in plankton.

+4.5 To demonstrate knowledge of zooplankton group characteristics, students will identify, draw, estimate size, and label representatives from the nine phyla of zooplankton using a plankton manual.

4.6 To demonstrate knowledge of data correlation, students will keep a record of the collecting site data and correlate it with specimens obtained from the site.

+4.7 To demonstrate knowledge of index components, students will determine the index components when given a population sample.

+4.8 To demonstrate knowledge of counting methods, students will compute the average population of the index components using three slides of the given sample.

4.9 To demonstrate knowledge of environmental conditions, students will identify the effects of environmental conditions on the population samples based on collection site data.

5.0 Macroscopic Marine Plankton Identification

5.1 To demonstrate knowledge of macroscopic plankton, students will:

*(1) identify the macroscopic forms of plankton as being Scyphozoa or Ctenophora; and

+(2) identify, draw, estimate size, and label representatives of the Scyphozoa and Ctenophora.

5.2 To demonstrate knowledge of scyphozoans, students will classify the scyphozoan plankton.

6.0 Exploration of the Marine Environment

*6.1 To demonstrate knowledge of underwater physics, students will:

(1) identify applications of Archimedes Principle, Boyle's Law, Charles' Law, and Dalton's Law as they relate to diving; and

(2) identify the effects of temperature, density, buoyancy, refraction or acoustics as they relate to diving.

6.2 To demonstrate knowledge of underwater physiology, students will:

*(1) identify the heart and blood vessels as the major parts of the human circulatory system that are affected by depth and pressure; and

*(2) identify the alveoli as the major part of the human respiratory system that is affected by depth and pressure.

6.3 To demonstrate knowledge of the medical aspects of diving, students will:

*(1) identify examples of the direct effects of pressure as squeezes or embolism and indirect effects of pressure as narcosis or shallow water blackout; and

(2) describe the proper treatment for cases of direct and indirect effects.

6.4 To demonstrate knowledge of diving equipment and safety, students will:

(1) identify the forms, purpose, and use of basic diving equipment;

(2) identify the forms, purpose, and use of SCUBA;

(3) identify the forms, purpose, and use of commercial diving equipment;

*(4) identify the standard rate of ascent as 60 feet per minute; and

(5) show the use of decompression tables by planning and solving decompression problems.

+7.0 Marine Vertebrate Dissection

*7.1 To demonstrate knowledge of the shark's external anatomy, students will identify structures and functions of selected parts of the external features of a shark.

*7.2 To demonstrate knowledge of the shark's digestive and urogenital systems, students will identify structures or functions of the liver, mesenteries, stomach, rugae, duodenum, ileum, spiral valve, ovaries, oviduct, shell gland, uterus, cloaca, testes, vas deferens, or sperm sacs from a diagram or description.

7.3 To demonstrate knowledge of the shark's respiratory and circulatory systems, students will identify structures and functions of selected respiratory and circulatory structures.

*7.4 To demonstrate knowledge of the shark's nervous system students will identify the structures or function of the canals of Lorenzini, olfactory system, conjunctiva, cerebrum, optic lobes, cerebellum, auricles, medulla oblongata, or vagus nerve from a diagram or description.

*7.5 To demonstrate knowledge of the shark's skeletal system, students will identify structures or functions of the precerebral cavity, rostral carina, supraorbital crest, occipital condyle, platopterygoquadrate cartilage, labial cartilage, Meckel's cartilage, centrum, coracoid bar, radials, or ceratotrichia from a diagram or description.

7.6 To demonstrate knowledge of the shark's muscle system, students will list origins and insertions for selected muscles.

+8.0 Macroscopic Marine Phyla

8.1 To demonstrate identification skills, students will:

(1) obtain specimens to be used for a collection;

(2) organize and categorize marine life into taxonomic orders;

(3) use an identification key to identify or classify specimens; and

(4) construct an identification key.

8.2 To demonstrate specimen preparation skills, students will prepare specimens using standard preserving methods.

9.0 Population Studies: Lincoln Index

9.1 To demonstrate knowledge of population studies, students will state the use of the Lincoln Index.

+9.2 To demonstrate population study skills, students will apply the Lincoln Index to a selected population.

10.0 Salinity Tolerance: Euryhaline Organisms

10.1 To demonstrate salinity tolerance laboratory skills, students will:

+(1) set up the appropriate apparatus and follow standard procedures used in performing a salinity tolerance experiment;

+(2) observe and record the organisms' feeding responses, respiration rates, and changes in general habits and appearance during the experiment as compared with a control situation;

(3) explain orally or in writing the total effect of the initial salinity change upon the organism;

+(4) reverse the salinity levels of the test organism back to normal levels and compare the results of this to 10.2 and the control; and

(5) explain orally or in writing the total effect of the reversal upon the organism.

10.2 To demonstrate data correlation skills, students will compile all results of the experiment and use standard graphing procedures.

KEY TO RECOMMENDED INSTRUCTIONAL MATERIALS

Performance Objective		Instructional Implications		Resources	
Number	Topic	Teaching Time	Tested On	County Adopted	Supplementary
1.0	Research Skills	2-3 weeks	MLST		J. E. Warriner, Warriner's English Grammar and Composition: Complete Course (New York: Harcourt, Brace and Jovanovich, 1977).
2.0	Marine Chemistry	1 week	MLST	B. H. McConnaughey, Introduction to Marine Biology (St. Louis: C.V. Mosby, 1974), pp. 28-35.	
3.0	Marine Ecology	6 weeks	MLST	McConnaughey, pp. 2-28, 36-55.	
4.0	Microscopic Marine Plankton Identification	2 weeks	MLST		Plankton of the St. Johns River (Marine Science Education Center, Duval County Public Schools, 1974).
5.0	Macroscopic Marine Plankton Identification	1 week	MLST		Plankton of the St. Johns River.

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KEY TO RECOMMENDED INSTRUCTIONAL MATERIALS

Performance Objective		Instructional Implications		Resources	
Number	Topic	Teaching Time	Tested On	County Adopted	Supplementary
6.0	Exploration of the Marine Environment	2 weeks	MLST		Jeppsen-Sandersen, Open Water Sport Diver Manual (Germany: Jeppsen-Sandersen Inc., 1978).
7.0	Marine Vertebrate Dissection	6 weeks	MLST		L. M. Ashley, Laboratory Anatomy of the Shark (Birmingham: Sargent-Welch, 1976), pp. 3-56.
8.0	Macroscopic Marine Phyla	3 weeks			Beakley, et al, The Source Book of Marine Sciences (Tallahassee: Department of Education, 1970), p. 55.
9.0	Population Studies: Lincoln Index	1 week			Beakley, p. 141.
10.0	Salinity Tolerance: Euryhaline Organisms	2 weeks			Beakley, p. 137.

County Adopted Text:

B. H. McConnaughey, Introduction to Marine Biology (St. Louis: C. V. Mosby, 1974).

KEY TO LABORATORY RESOURCES

Objective	Skill	County Adopted Text Pages	Other Resources
	Students will:		
+1.2.2	gather data using standard laboratory and field equipment.		John Beakley, Source Book of Marine Sciences (Tallahassee, Florida: Department of Education, 1970), p. 105.
+2.1.1	measure the pH of a liquid using standard laboratory procedures.		Beakley, p. 35.
+3.2	set up and maintain a closed-system ecosystem.		Beakley, p. 1.
+3.6	identify and classify given samples of sediments as to their size, shape, weight, composition, mineral content, and porosity.		Beakley, p. 23.
+4.5	identify, draw, estimate size, and label representatives from the nine phyla of zooplankton using a plankton manual.		Plankton of the St. Johns River (Marine Science Education Center, Duval County Public Schools, 1974), pp. 1-60

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KEY TO LABORATORY RESOURCES

Objective	Skill	County Adopted Text Pages	Other Resources
	Students will:		
+4.7	determine the index components when given a population sample.		Beakley, p. 61.
+4.8	compute the average population of the index components using three slides of the given sample.		Beakley, p. 61.
+5.1.2	identify, draw, estimate size, and label representatives of the Scyphozoa and Ctenophora.		Plankton of the St. Johns River, pp. 1-60
+7.0	dissect marine vertebrates.		L. M. Ashley, Laboratory Anatomy of the Shark (Birmingham: Sargent-Welch, 1976), pp. 1-56.
+8.0	identify macroscopic marine specimens.		Beakley, p. 55.
+9.2	apply the Lincoln Index to a selected population.		Beakley, p. 141.

KEY TO LABORATORY RESOURCES

Objective	Skill	County Adopted Text Pages	Other Resources
	Students will:		
+10.0	study salinity tolerance using euryhaline organisms.		Beakley, p. 137.

INTRODUCTION
MARINE SCIENCE

State Accreditator Number. . 1369
Course Code Number 2240
F.T.E. Category. 1.10
Instructional Level. . . . . Standard

Report Card Abbreviation . . Marine Sci
Length of Course . . . . . Year
Credit . . . . . 1 Science credit
Grade Level. 10, 11, 12

Prerequisites

None

Textbook(s)

Weisberg, J. and Parrish, H., Introductory Oceanography (New York: McGraw-Hill Company, 1974).

Notes to Teachers

Full objectives in addition to Minimum Level Skills (MLS) objectives are included in the performance objectives for Marine Science. Students are to develop laboratory skills as well as content knowledge.

The MLS objectives are indicated with an asterisk (*) and will be the only objectives tested on the Minimum Level Skills Test (MLST). The "Teaching Time" listed on the "Key to Instructional Materials" is a suggested maximum for each objective to help insure that all MLS objectives can be met by MLST time.

Laboratory skills are indicated with a plus sign (+). Suggested resources for teaching the laboratory skills have been listed at the end of this section of the teacher's guide. Because content for performance objectives 7.0, 8.0, and 9.0 is not found in the county adopted text, the Marine Science Resource Packet containing this material plus some student worksheets and transparency masters may be obtained by calling the science office , 633-6170. Other resources may be substituted for or added to suggested laboratory resources.

MARINE SCIENCE

1.0 Man and the Sea

- 1.1 Diving: Equipment/ Applications
  - 1.1.1 Equipment: sport, commercial
  - 1.1.2 Applications
  - *1.1.3 Medical problems
  - 1.1.4 Decompression
  - *1.1.5 Submersibles
- 1.2 Ocean Technology
  - 1.2.1 Desalination
  - 1.2.2 Oil drilling
  - *1.2.3 Mineral recovery
  - 1.2.4 Shipping innovations
  - *1.2.5 Climatology
  - 1.2.6 Commercial fishing
  - *1.2.7 Aquaculture

2.0 Marine Instrumentation

- 2.1 Biological Instruments
  - *2.1.1 Instrument identification
  - 2.1.2 Operation/Use
  - +*2.1.3 Organisms caught
- 2.2 Geological Instruments
  - *2.2.1 Instrument identification
  - 2.2.2 Operation/Use
  - *2.2.3 Samples/Collecting data
- 2.3 Navigation
  - 2.3.1 Compass
  - 2.3.2 Site location
  - +2.3.3 Charting course
- 2.4 Instruments: Physical/ Chemical
  - *2.4.1 Instrument identification
  - 2.4.2 Operation/Use
  - *2.4.3 Information obtained

3.0 Geology of the Ocean

- 3.1 Continental Drift
  - *3.1.1 Sea floor spreading
  - 3.1.2 Plate tectonics
- 3.2 Sea Floor Materials
  - 3.2.1 Origins
  - *3.2.2 Pelagic sediments
  - 3.2.3 Oozes: chemical composition
  - *3.2.4 Oozes: source
  - 3.2.5 Distribution: pelagic sediments
  - *3.2.6 Terrigenous sediment
  - 3.2.7 Terrigenous color
  - 3.2.8 Distribution: terrigenous sediments
  - *3.2.9 Authigenic deposits/ example
  - 3.2.10 Sediment devoid areas
  - 3.2.11 Cores: geologic history
- *3.3 Topographical Features: Continental Margins
- *3.4 Topographical Features: Ocean Basin
- 3.5 Topographical Features: Cross-Section Profile
  - +3.5.1 Construction of profile
  - 3.5.2 Cross-section drawing

4.0 Chemical and Physical Properties of Seawater

- 4.1 Water Molecule

* Indicates Minimum Level Skills
\+ Indicates Laboratory Skills

MARINE SCIENCE

- 4.2 Chemical Factors
  - 4.2.1 Dissolved gases
  - 4.2.2 Elements
  - 4.2.3 Origin: components
  - *4.2.4 Salinity definition
  - *4.2.5 Salinity: causes, variation
  - 4.2.6 Salinity distribution
  - 4.2.7 Salinity: effects on organisms
  - *4.2.8 pH definition
  - +4.2.9 pH measurement
  - *4.2.10 Factors affecting pH
- 4.3 Physical Factors
  - 4.3.1 Pressure
  - *4.3.2 Temperature variations
  - *4.3.3 Density definition
  - *4.3.4 Density changes
  - +4.3.5 Density measurement
  - 4.3.6 Circulation
  - 4.3.7 Light: importance

5.0 Physical Oceanography
- 5.1 Wind/Waves
  - *5.1.1 Definitions
  - *5.1.2 Wave parts
  - 5.1.3 Seismic waves
  - 5.1.4 Storm waves
  - +5.1.5 Wave apparatus
- *5.2 Breaking Shore Waves
- 5.3 Reflection/Refraction
- 5.4 Currents
  - 5.4.1 Definition
  - *5.4.2 Coriolis effect
  - 5.4.3 Movements/ Circulation patterns
- 5.5 Tides
  - *5.5.1 Definition
  - 5.5.2 Spring/Neap tides
  - 5.5.3 Diurnal/ Semidiurnal
  - 5.5.4 Mixed tides
  - 5.5.5 Tide tables

6.0 Marine Ecology
- *6.1 Trophic Levels
  - 6.1.1 Definitions
  - 6.1.2 Consumer feeding levels
- *6.2 Biogeochemical Cycles
- 6.3 Marine Environment Divisions
  - 6.3.1 Benthic environments
  - 6.3.2 Pelagic environments

7.0 Marine Ecosystems
- 7.1 Dunes
  - 7.1.1 Physical factors
  - *7.1.2 Sea oats
  - *7.1.3 Role of dune grasses
- *7.2 Salt Marshes/Estuaries
  - 7.2.1 Physical/Chemical factors
  - 7.2.2 Biological components
  - 7.2.3 Economic benefit
  - 7.2.4 Biological importance
- 7.3 Mangrove Marsh
  - 7.3.1 Physical/Chemical factors
  - 7.3.2 Biological components
  - *7.3.3 Importance

MARINE SCIENCE

*7.4 Beaches
- 7.4.1 Definition
- +7.4.2 Classification
- 7.4.3 Physical factors
- 7.4.4 Organisms

7.5 Coral Reefs
- *7.5.1 Types
- *7.5.2 Composition
- 7.5.3 Physical factors
- 7.5.4 Biological nature
- *7.5.5 Functions

7.6 Abyssal Zone
- 7.6.1 Location
- 7.6.2 Physical factors
- *7.6.3 Biological features
- *7.6.4 Importance

8.0 Marine Pollution

8.1 Types

8.2 Oil
- 8.2.1 Causes
- *8.2.2 Effects

8.3 Thermal
- 8.3.1 Cause
- *8.3.2 Effect

8.4 Raw Sewage
- 8.4.1 Cause
- *8.4.2 Effects

8.5 Chemical
- 8.5.1 Causes
- *8.5.2 Effects

8.6 Preventive Measures

9.0 Marine Organisms

+9.1 Classification

9.2 Four Kingdom System
- 9.2.1 Plant/Animal/ Protista/Monera
- 9.2.2 Examples
- +9.2.3 Specimen classification

9.3 Animal Kingom
- 9.3.1 Divisions
- 9.3.2 Names/ Characteristics
- +9.3.3 Observations

9.4 Protist Kingdom
- 9.4.1 Division
- 9.4.2 Characteristics
- +9.4.3 Observations

9.5 Monera Kingdom
- 9.5.1 Divisions
- 9.5.2 Characteristics
- +9.5.3 Observations

PERFORMANCE OBJECTIVES
MARINE SCIENCE

To demonstrate the ability to recall and apply knowledge of man and the sea, marine instrumentation, geology of the ocean, chemical and physical properties of seawater, physical oceanography, marine ecology, marine ecosystems, marine pollution, and marine organisms, students will master the performance objectives listed below. Successful completion of this course is based on teacher judgement and the requirement that students pass the Minimum Level Skills Test.

Performance Objectives

1.0 Man and the Sea

1.1 To dumonstrate knowledge of diving, students will:

(1) give examples of equipment used in SCUBA and commercial diving;

(2) distinguish between the application of sport and commercial diving;

*(3) identify the medical problems associated with commercial and sport diving;

(4) identify decompression as related to diving; and

*(5) identify the types of submersibles used in underwater exploration.

1.2 To demonstrate knowledge of ocean technology, students will:

(1) describe the process of desalination;

(2) describe methods of drilling for oil from beneath the sea floor;

*(3) identify oil, manganese, uranium, iodine, magnesium, salt, bromine, or lime as important mineral resources which can be recovered from the sea;

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* Indicates Minimum Level Skills
+ Indicates Laboratory Skills

(4) identify shipping innovations;

*(5) identify how climate and weather are affected by ocean currents;

(6) identify methods and problems encountered in commercial fishing; and

*(7) identify methods and problems enccuntered in aquaculture.

2.0 Marine Instrumentation

2.1 To demonstrate knowledge of biological instruments, students will:

*(1) identify the plankton net, dredge, seine, and trawl net when given diagrams;

(2) explain the use of plankton net, dredge, seine, and trawl net; and

+*(3) identify the types of organisms collected by the plankton net, dredge, seine, and trawl net.

2.2 To demonstrate knowledge of geological instruments, students will:

*(1) identify the corer, dredge, echo sounder, and grabber when given a diagram;

(2) explain the use of the corer, dredge, echo sounder, and grabber; and

*(3) identify the kinds of data or samples obtained by the corer, dredge, echo sounder, and grabber.

2.3 To demonstrate knowledge of navigation, students will:

(1) make a compass;

(2) locate points on a navigational chart when given the coordinates; and

+(3) chart a course when given a navigational chart and parallel rules.

2.4 To demonstrate knowledge of chemical and physical instruments, students will:

*(1) identify the Secchi disk, hydrometer, Nansen bottle, current meter, drift bottle, and titration apparatus when given diagrams;

(2) describe the use of the Secchi disk, hydrometer, Nansen bottle, current meter, drift bottle, and titration apparatus; and

*(3) identify the types of information obtained from the Secchi disk, hydrometer, Nansen bottle, current meter, drift bottle, and titration apparatus.

3.0 Geology of the Ocean

3.1 To demonstrate knowledge of continental drift, students will:

*(1) identify sea floor spreading as an explanation for continental drift; and

(2) identify the effects of plate tectonics on continental drift.

3.2 To demonstrate knowledge of sea floor materials, students will:

(1) identify the origins of sea floor materials as mainly pelagic or terrigenous;

*(2) identify sea-derived pelagic sediments as organic oozes or inorganic red clay deposits;

(3) identify the chemical composition of organic oozes as siliceous or calcareous;

*(4) identify the main source of organic oozes as the skeletal material of planktonic forms;

(5) identify the distribution of pelagic sediments as deep sea;

*(6) identify the composition of terrigenous sediments as eroded land-based materials;

(7) identify the color of terrigenous materials as the method by which their chemical composition is determined;

(8) identify the distribution of terrigenous sediments as being on the sea floor, close to land;

*(9) identify manganese nodules as examples of authigenic deposits;

(10) identify some sea floor areas as being devoid of sediment; and

(11) identify cores as used to indicate geologic changes.

*3.3 To demonstrate knowledge of topographical features of the continental margin, students will identify the continental shelf, continental slope, and continental rise when given a cross-section profile diagram.

*3.4 To demonstrate knowledge of topographical features of the ocean basin, students will identify a trench, mid-ocean ridge, rift valley, seamount, guyot, and island when given a cross-section profile diagram.

3.5 To demonstrate knowledge of topographical features of cross-section profiles, students will:

+(1) construct a cross-section profile of the sea floor when given a pan of wet sand and popsicle sticks; and

(2) draw a cross-section profile of the sea floor when given the location and depths of soundings.

4.0 Chemical and Physical Properties of Seawater

4.1 To demonstrate knowledge of water molecules, students will identify the water molecule as being bipolar.

4.2 To demonstrate knowledge of chemical factors of seawater, students will:

(1) identify the dissolved gases found in seawater and their importance;

(2) list the major elements found in seawater;

(3) identify the origins of the components of seawater;

*(4) identify the definition of salinity;

*(5) identify the effect of temperature, runoff, or evaporation on salinity;

(6) identify the distribution of salinity variations due to temperature, depth, runoff, and evaporation;

(7) identify the definitions of stenohaline and euryhaline;

*(8) identify pH as the degree of acidity or alkalinity in a given volume of seawater or as measured on a linear scale of 0 to 14 with 7 being neutral, 14 being strongly alkaline, and 0 being strongly acidic;

+(9) measure pH of liquids with a pH meter, acid and base indicator paper, or other method; and

*(10) identify decaying trees and coral reefs sand as natural factors that affect pH of seawater.

4.3 To demonstrate knowledge of the physical factors of seawater, students will:

(1) identify the effects of temperature and pressure on life at great depths;

*(2) identify temperature variations, isotherms, mixed layer, thermocline, bottom layer, and upwelling when given a diagram of the distribution of temperature of the sea as it varies with depth;

*(3) identify the definition of density;

*(4) identify the change in density as it varies with temperature and salinity;

+(5) use a hydrometer to measure the density of seawater or salt water;

(6) explain the importance of currents in maintaining life in the ocean; and

(7) identify the photic and the aphotic zones of the ocean and the primary importance of light to life in the ocean.

5.0 Physical Oceanography

5.1 To demonstrate knowledge of wind and waves, students will:

*(1) identify the definitions of wave velocity, wave period, fetch, and swell;

*(2) identify the crest, trough, wave height, and wavelength when given an appropriate diagram;

(3) identify a description of seismic waves;

(4) identify the effects of storm waves; and

+(5) produce and identify a crest, trough, and breaker using a wave apparatus.

*5.2 To demonstrate knowledge of the breaking of shore waves, students will identify the conditions which cause a wave to break on shore.

5.3 To demonstrate knowledge of reflection and refraction, students will describe the processes of reflection and refraction of waves.

5.4 To demonstrate knowledge of currents, students will:

(1) identify the definition of current;

*(2) identify an example of the Coriolis effect on water; and

(3) identify the movements of currents as being in circular or parallel patterns.

5.5 To demonstrate knowledge of tides, students will:

*(1) identify the definition of tides;

(2) identify the definitions of spring tides and neap tides;

(3) describe the differences between diurnal and semidiurnal for a specific tide when given the number of tides per day; and

(4) describe mixed tides; and

(5) predict high and low tides when given tide tables.

6.0 Marine Ecology

*6.1 To demonstrate knowledge of trophic levels, students will:

(1) identify the definitions of the trophic levels of food chains as being producer, consumer, and decomposer; and

(2) identify the feeding levels of consumers as being herbivore, first level carnivore, second level carnivore, and top carnivore when given a marine food chain.

*6.2 To demonstrate knowledge of biogeochemical cycles, students will classify examples of the water, oxygen, nitrogen, and carbon cycles.

6.3 To demonstrate knowledge of divisions of the marine environment, students will:

(1) identify from a gross-section profile, a beach, salt marsh, mangrove marsh, coral reef, continental shelf, continental slope, continental rise, and abyss as being benthic environments; and

(2) identify from a cross-section profile the inshore, oceanic-photic and oceanic-aphotic divisions of the pelagic region.

7.0 Marine Ecosystems

7.1 To demonstrate knowledge of dunes, students will:

(1) identify the effects of wind, salt spray, temperature, moisture, and substrate on life in dunes;

*(2) identify sea oats as plants around which sand dunes form; and

*(3) identify the role of beach grasses in preventing beach erosion and in beach succession.

*7.2 To demonstrate knowledge of salt marshes and estuaries, students will:

(1) identify the effects of salinity variation, tidal range, wind, temperature, and water sources on life in salt marshes and estuaries;

(2) identify detritus, grasses, algae, marsh animals and juvenile sea animals as biological components of the salt marshes and estuaries;

(3) identify the high productivity of the salt marsh and estuary when compared to other ecosystems as being an economic benefit; and

(4) identify salt marshes and estuaries as being nursery grounds for many organisms.

7.3 To demonstrate knowledge of mangrove marshes, students will:

(1) identify the effects of salinity variation, tidal range, temperature, and muddy substrate on life in mangrove marshes;

(2) identify mangroves, tree oysters, and mangrove micro-ecosystems as biological components of the mangrove marsh; and

*(3) identify the importance of mangroves as building new land and protecting coral reefs from effects of erosion.

*7.4 To demonstrate knowledge of beaches, students will:

(1) identify the definition of a beach;

+(2) identify particle size as a method of classifying beaches as rocky, sandy, or muddy;

(3) identify the effects of sunlight, wave action, currents, erosion, and tidal changes on rocky, sandy, or muddy beaches; and

(4) identify the organisms common to each type of beach.

7.5 To demonstrate knowledge of coral reefs, students will:

*(1) identify a coral reef as either a fringing, barrier, or atoll reef;

*(2) identify the chemical composition of the skeletons which make up the bulk of coral reefs;

(3) identify the effects of temperature, depth, turbidity, wave action, currents, and lack of sunlight on coral reefs;

(4) identify coral reefs as being alive on their surfaces, and

*(5) identify coral reefs as a habitat and food source for other forms of life.

7.6 To demonstrate knowledge of the abyssal zone, students will:

(1) identify the abyssal zone on a diagram;

(2) identify the effects of darkness, pressure, temperature, and depth on life in the abyssal zone;

*(3) identify bioluminescense, small fish size, lack of plants, and few different kinds of animal forms as being biological factors of the abyssal zone; and

*(4) identify economic benefits of mineral deposits as the reason why the abyssal zone is important.

8.0 Marine Pollution

8.1 To demonstrate knowledge of marine pollution, students will identify the types of marine pollution as oil, thermal, raw sewage, and chemical.

8.2 To demonstrate knowledge of marine oil pollution, students will:

(1) identify the main causes of marine oil pollution as shipping wastes and oil spills; and

*(2) identify the main effects of marine oil pollution as death of associated organisms and economic loss to fishing and tourist industries.

8.3 To demonstrate knowledge of marine thermal pollution, students will:

(1) identify the main cause as heated discharge water from power plants; and

*(2) identify the main effect as fish kills.

8.4 To demonstrate knowledge of marine raw sewage pollution, students will:

(1) identify the main cause of marine raw sewage pollution as improperly treated human intestinal wastes; and

*(2) identify the main effects as high Escherichia Coli count, contaminated shell fish, and contagious diseases, such as typhoid, hepatitis, cholera, etc.

8.5 To demonstrate knowledge of marine chemical pollution, students will:

(1) identify the main causes of marine chemical pollution as land runoff of pesticides, fertilizers, radioactive materials, and industrial wastes; and

*(2) identify the main effects as algae blooms, pesticide accumulation in the bodies of higher animals, or death.

8.6 To demonstrate knowledge of preventive measures for pollution, students will state preventive measures for marine pollution.

9.0 Marine Organisms

+9.1 To demonstrate knowledge of classification, students will identify characteristics and structure as criteria by which organisms are classified.

9.2 To demonstrate knowledge of the four kingdom system of classification, students will:

(1) identify the four kingdoms as being Plant, Animal, Protista, and Monera;

(2) identify examples of the plant, animal, protist, and moneran kingdoms; and

+(3) collect and classify specimens as being members of the plant, animal, protist, and moneran kingdoms.

9.3 To demonstrate knowledge of the animal kingdom, students will:

(1) identify the major divisions of the animal kingdom;

(2) identify common names and characteristics of selected marine animals; and

+(3) observe, draw, and name selected marine animals.

9.4 To demonstrate knowledge of the protist kingdom, students will:

(1) identify phytoplankton, other algae, and protozoans as divisions of the protist kingdom;

(2) identify the characteristics of phytoplankton, other algae, and protozoans; and

+(3) observe, draw, and name specimens of phytoplankton and protozoans.

9.5 To demonstrate knowledge of the moneran kingdom, students will:

(1) identify bacteria and blue-green algae as members of the moneran kingdom;

(2) identify the characteristics of the moneran kingdom; and

+(3) observe specimens of bacteria and blue-green algae.

KEY TO RECOMMENDED INSTRUCTIONAL MATERIALS

Performance Objective		Instructional Implications		Resources	
Number	Topic	Teaching Time	Tested On	County Adopted	Supplementary
1.0	Man and the Sea	2 weeks	MLST	J. Weisberg and H. Parrish, Introductory Oceanography (New York: McGraw-Hill Book Company), pp. 193-237, 257-69, 287-89.	
2.0	Marine Instrumentation	2 weeks	MLST	Weisberg, pp. 23-50.	B. Pipkin, et al. Laboratory Exercises in Oceanography (San Francisco: W. H. Freeman and Company, 1977), p. 25. J. Hallett, Ninth Grade Oceanography Unit (Duval County Public Schools, Marine Science Education Center, 1974), pp. 15-16. Pipkin, pp. 27-41, 43-54.
3.0	Geology of the Ocean	4 weeks	MLST	Weisberg, pp. 53-115.	P. S. Meadows, et al, An Introduction to Marine Science (New York; John Wiley and Sons, 1978), pp. 70-94.

KEY TO RECOMMENDED INSTRUCTIONAL MATERIALS

Performance Objective		Instructional Implications		Resources	
Number	Topic	Teaching Time	Tested On	County Adopted	Supplementary
					Coastal Awareness: A Resource for Teachers in Senior High Science (National Oceanographic and Atmospheric Administration, 1978). Hallett, pp. 9, 12.
4.0	Chemical and Physical Properties of Seawater	4 weeks	MLST	Weisberg, pp. 117-32, 239-49.	Meadows, pp. 25-49. Pipkin, pp. 61-83. Hallett, pp. 1-16.
5.0	Physical Oceanography	6 weeks	MLST	Weisberg, pp. 135-89.	Meadows, pp. 8-24. Pipkin, pp. 83-126. Hallett, pp. 5-7, 10-11.
6.0	Marine Ecology	3 weeks	MLST	Weisberg, pp. 257-59.	Marine Science Resource Packet (Duval County Public Schools, 1980). Meadows, pp. 25-49, 95-113. Pipkin, pp. 157-72.

KEY TO RECOMMENDED INSTRUCTIONAL MATERIALS

Performance Objective		Instructional Implications		Resources	
Number	Topic	Teaching Time	Tested On	County Adopted	Supplementary
					D. R. Houston, Understanding the Game of the Environment, Agriculture Information Bulletin No. 426 (Washington: U. S. Government Printing Office, 1979), pp. 10-35.
7.0	Marine Ecosystems	7 weeks	MLST	Weisberg, pp. 110-111, 166, 183, 239-55.	Meadows, pp. 49-69, 131-43. Pipkin, pp. 8-29, 205-12. Marine Science Resource Packet
8.0	Marine Pollution	2 weeks	MLST	None	H. Nunn, Marine Chemistry (Duval County Public Schools, Marine Science Education Center, 1974). Houston, pp. 122-41. Marine Science Resource Packet.

KEY TO RECOMMENDED INSTRUCTIONAL MATERIALS

Performance Objective		Instructional Implications		Resources	
Number	Topic	Teaching Time	Tested On	County Adopted	Supplementary
9.0	Marine Organisms	6 weeks		None	Marine Science Resource Packet. W. L. Smallwood and E. Green, Biology (Morristown, New Jersey: Silver Burdett Company, 1971), pp. 255-85.

KEY TO LABORATORY RESOURCES

Objective	Skill	County Adopted Text Pages	Other Resources
	Students will:		
+2.1.3	identify the type of organisms collected by the plankton net dredge, seine, and trawl net.		Field trip to Marine Science Education Center
+2.3.3	chart a course when given a navigational chart and parallel rules.		Marine Science Resource Packet (Duval County Public Schools, 1980).
+3.5.1	construct a cross-section profile of the sea floor when given a pan of wet sand and popsicle sticks.		Marine Science Resource Packet,
+4.2.9	Measure pH of liquids with a pH meter, acid and base indicator paper, or other method.		
+4.3.5	use a hydrometer to measure the density of seawater or salt water.		Coastal Awareness: A Resource for Teachers in Senior High Science (National Oceanographic and Atmospheric Administration, Washington, D.C., 1978), pp. 39-40.

KEY TO LABORATORY RESOURCES

Objective	Skill	County Adopted Text Pages	Other Resources
	Students will:		
+5.1.5	produce and identify a crest trough, and breaker using a wave apparatus.		Marine Science Resource Packet.
+9.1	identify characteristics and structure as criteria by which organisms are classified.		Marine Science Resource Packet.
+9.2.3	collect and classify specimens as being members of the plant, animal, protist, and moneran kingdoms.		Marine Science Resource Packet. Field trip to Marine Science Education Center
+9.3.3	observe, draw, and name selected marine animals.		Marine Science Resource Packet.
+9.4.3	observe, draw, and name specimens of phytoplankton and protozoans.		Marine Science Resource Packet. Plankton of the St. Johns River (Marine Science Education Center, 1977).
+9.5.3	observe specimens of bacteria and blue green algae.		

INTRODUCTION
SCIENCE RESEARCH, ADVANCED

State Accreditator Number. . 1329
Course Code Number 2511
F.T.E. Category. 1.10
Instructional Level. . . . . Advanced

Report Card Abbreviation . . Sci Research Adv
Length of Course . . . . . Year
Credit . . . . . 1 Science credit
Grade Level. 11, 12

Prerequisites

Departmental approval (see "Notes to Teachers, " below); current enrollment in Biology II, Advanced; Chemistry II, Advanced; Physics II, Advanced; or Marine Biology II, Advanced

Textbook(s)

None

Performance Objective

The senior high science student will complete an independent research project, presenting the results both orally and in writing to the satisfaction of the teacher.

Notes to Teachers

The Science Research course is designed to provide opportunity for interested students to participate in extensive, directed, individual research. Although there is much flexibility for both teacher and student, it is necessary that certain minimum standards be followed to ensure that advanced credit is warranted.

Prerequisites for acceptance into the course are:

1. Current enrollment in Biology II, Advanced; Chemistry II, Advanced; Marine Biology II, Advanced; or Physics II, Advanced.

2. Teacher recommendation

3. Submission of a one-page project proposal by the student and subsequent approval by the teacher

4. Availability of laboratory equipment and supplies necessary for planned laboratory research

5. Verification of student knowledge of lab safety procedures based upon an interview by a previous teacher

Minimum Project Requirements

1. A minimum of 75 hours spent in the field or laboratory

2. Preparation of a paper whose format conforms to accepted standards for publication of research in scientific journals, e.g. Science. The paper will include:

   (1) introduction with statement of problem and hypothesis,

   (2) background research,

   (3) description of experimental design, including identification of variables and controls,

   (4) data collected, presented in tables, graphs, and diagrams, and

   (5) conclusions.

3. Weekly contact between teacher and student regarding progress of the project; students may not contact local agency personnel without teacher assistance and approval.

4. Results of student project must be presented to an advanced class, entered in the Junior Academy of Science program, or entered in the science fair. The student should prepare all visuals for the presentation.

Suggested Guidelines for Background Research

The topic for research may be assigned by the teacher or selected by the student. It is recommended that topics be of such a nature that current information (e.g., periodicals) is available. The text of the completed paper should be the equivalent of 10-15 typed, double-spaced pages. Prior to the final paper, preliminary products will be reviewed by the teacher. A guide for each product follows:

1. Working Bibliography

The working bibliography is a listing, in proper bibliographic form, of possible sources of information for the paper. It is recommended that this product be completed on note cards, with each entry on a separate card. It might be helpful to the student to include the location of each source (school media center, Hayden Burns Library, etc.) on each card.

2. Note Cards

During the process of gathering data for the paper, careful notes should be taken and recorded on index cards. No information should appear in the final paper which is not on a note card. The student should keep three basic guidelines in mind: (1) no more than one main idea should be recorded on one card; (2) the source of the information, including page numbers, must be on the card; and (3) if the information is quoted directly, quotation marks must be used. The note cards can be shuffled and rearranged as the order of the content for the paper is decided.

3. Outline

The formation of the outline is the first attempt to "weed out" and sort through the information obtained to determine what data are relevant and how the final paper should be organized. Standard outline form should be used. The outline should not be so detailed as to include actual data from the note cards. In general, the outline will be two to four pages long.

4. Rough Draft

The rough draft is basically the final paper without the exact degree of concern for neatness. This is the student's last opportunity to be certain that he is working properly. It is recommended that the outline, which has been previously evaluated, be turned in with the rough draft for comparison.

5. Final Paper

The final paper is the culmination of previous products. Basically, the rough draft, with teacher-recommended changes, should be put into final form. It should consist of a title page, body of paper, footnotes, and bibliography page. Footnotes and bibliography should be done in a standard form as selected by the teacher. The final bibliography will consist of a minimum of six sources, including no more than two encyclopedias and at least one non-book source.

INTRODUCTION
SCIENCE SURVEY - EARTH/SPACE

State Accreditator Number. . 1343
Course Code Number 2264
F.T.E. Category. 1.10
Instructional Level. . . . . Standard

Report Card Abbreviation . . Sci Survey-E/S
Length of Course . . . . . Year
Credit . . . . . 1 Science credit
Grade Level. 10, 11, 12

Prerequisites

None

Textbook(s)

Ramsey, W. L., et al, Holt Earth Science (New York: Holt, Rinehart, and Winston, Inc., 1978).

Notes to Teachers

Changes have been made in the content and format of the Course Outline and in the Performance Objectives for Science Survey - Earth/Space. Objective 6.0 is no longer tested on the MLST.

The MLS objectives are indicated with an asterisk (*), and will be the only objectives tested on the Minimum Level Skills Test (MLST). The "Teaching Time" listed on the Key to Instructional Materials is a suggested maximum time for each objective to help insure that all MLS objectives can be met by MLST time.

Laboratory skills are indicated with a plus sign (+). Suggested resources for teaching the laboratory skills have been listed at the end of the section of the teacher's guide. Other resources may be substituted for or added to suggested laboratory resources. In both the instructional materials key and the laboratory resources key, resources are listed in rank order of importance.

SCIENCE SURVEY - EARTH/SPACE

1.0 Research Skills

- 1.1 Research Skills
  - 1.1.1 Observation patterns
  - *1.1.2 Hypothesis definition
  - 1.1.3 Experiment design
  - *1.1.4 Graph interpretation
- *1.2 Metric Measurement Units
- +1.3 Mass/Density

2.0 Earth Composition

- *2.1 Earth Divisions
- *2.2 Mineral Identification
- +2.3 Mineral Hardness
- *2.4 Rocks: Igneous/ Sedimentary/Metamorphic
- +2.5 Crystal Formation
- *2.6 Sediment
- +2.7 Metamorphic Formation
- +2.8 Sedimentary Formation
- 2.9 Rock Cycle
- *2.10 Weathering: Physical/ Chemical
- +2.11 Chemical Weathering Experiment
- +2.12 Physical Weathering Experiment
- *2.13 Soil: Humus
- 2.14 Soil Formation
- +2.15 Soil Examination
- 2.16 Porosity/Permeability
- 2.17 Water Table
- +2.18 Porosity Experiment
- *2.19 Water Supply
- 2.20 Limestone Caverns/ Sinkholes

3.0 Earth Activity

- *3.1 Crust/Mantle/Core
- 3.2 Theory of Plate Tectonics
- 3.3 Earthquakes
  - *3.3.1 Faults
  - 3.3.2 Relationship: plates, faults, earthquakes
  - *3.3.3 Seismograph
  - 3.3.4 Locations
  - +3.3.5 Waves: primary, secondary
- 3.4 Volcanoes
  - *3.4.1 Magma/Lava
  - 3.4.2 Structure
  - 3.4.3 Mt. St. Helens
  - 3.4.4 Locations
- *3.5 Weathering/Erosion
- *3.6 Water Cycle
- 3.7 Water Erosion
- *3.8 Glaciers
- 3.9 Wind Erosion
- *3.10 Shoreline Erosion
- +3.11 Glacial Erosion Experiment
- +3.12 Wind Erosion Experiment

4.0 Weather

- *4.1 Atmospheric Gases
- 4.2 Air Pollutants
- *4.3 Barometer
- 4.4 Atmospheric Energy
  - 4.4.1 Greenhouse effect
  - *4.4.2 Convection definition
  - 4.4.3 Surface heating
  - +4.4.4 Convection experiment
  - +4.4.5 Unequal heating experiment
- *4.5 Breezes: Mountain/Valley/ Land/Sea
- 4.6 Water Vapor
  - *4.6.1 Humidity/Relative humidity
  - *4.6.2 Wet/Dry bulb thermometer
  - +4.6.3 Measurement: relative humidity
  - *4.6.4 Condensation
  - 4.6.5 Dew/Frost

* Indicates Minimum Level Skills
\+ Indicates Laboratory Skills

SCIENCE SURVEY - EARTH/SPACE

- 4.7 Clouds
  - 4.7.1 Formation
  - *4.7.2 Types
  - +4.7.3 Dew point determination
- *4.8 Climate
- 4.9 Severe Weather Conditions
  - 4.9.1 Thunderstorm/ Lightning
  - *4.9.2 Hurricane/Tornado
  - 4.9.3 Path: hurricane
- 4.10 Weather Forecasting
  - *4.10.1 Function: instruments
  - 4.10.2 Observations
  - 4.10.3 Weather map
  - 4.10.4 Prediction

5.0 Solar System/Space Exploration

- *5.1 Rotation
- *5.2 Revolution
- 5.3 Gravity
- *5.4 Earth Orbit
- 5.5 Moon
  - *5.5.1 Natural satellite
  - 5.5.2 Phases
  - 5.5.3 Revolution period
  - *5.5.4 Lunar eclipse
  - 5.5.5 Surface conditions
- 5.6 Sun
  - *5.6.1 Sunspots
  - 5.6.2 Energy source
  - +5.6.3 Separation: white light
- *5.7 Telescope
- 5.8 Solar System
  - *5.8.1 Planets' order
  - 5.8.2 Planet characteristics
  - 5.8.3 Asteroids/Meteors/ Comets
  - +5.8.4 Models: planet orbits
- 5.9 Stars
  - *5.9.1 Constellations
  - 5.9.2 Color
  - 5.9.3 Life history
  - 5.9.4 Galaxy/Universe
- 5.10 NASA
  - *5.10.1 U.S. government agency
  - 5.10.2 Functions

6.0 Oceanography

- 6.1 Sea Floor Features
- 6.2 Salinity
  - 6.2.1 Definition
  - 6.2.2 Sea water elements
- 6.3 Ocean Movement
  - 6.3.1 Current description
  - 6.3.2 Current causes
  - +6.3.3 Determination: density
  - 6.3.4 North Atlantic currents
  - +6.3.5 Wind effect: observation
  - +6.3.6 Density currents: observation
- 6.4 Waves
  - 6.4.1 Surface waves
  - 6.4.2 Parts
  - 6.4.3 Formation: breakers
  - 6.4.4 Tides: cause

PERFORMANCE OBJECTIVES
SCIENCE SURVEY - EARTH/SPACE

To demonstrate the ability to recall and apply knowledge of research skills, earth composition, earth activity, weather, solar system, and space exploration, students will master the performance objectives listed below. Successful completion of this course is based on teacher judgement and the requirement that students pass the Minimum Level Skills Test.

Performance Objectives

1.0 Research Skills

1.1 To demonstrate knowledge of the research skills, students will:

(1) identify a pattern in a set of observations;

*(2) identify a definition of hypothesis;

(3) design an experiment to test a hypothesis; and

*(4) interpret a graph from recorded weather data.

*1.2 Students will identify metric measurement units of mass, length, and volume.

+1.3 Students will determine the mass and density of a rock using appropriate laboratory equipment.

2.0 Earth Composition

*2.1 Students will identify the three divisions of the earth: lithosphere, hydrosphere, and atmosphere.

*2.2 Students will identify mineral identification properties: luster, color, texture, heft, streak, fracture, cleavage, and hardness.

+2.3 Students will test the degree of hardness of objects using the scratch test and the mineral hardness scale.

*2.4 Students will identify the definitions of igneous, sedimentary, and metamorphic rocks.

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* Indicates Minimum Level Skills
\+ Indicates Laboratory Skills

+2.5 Students will determine the relationship between cooling rate and crystal size by experimentation.

*2.6 Students will identify a definition of sediment.

+2.7 Students will use modeling clay to demonstrate the formation of metamorphic rock.

+2.8 Students will construct a model of sedimentary rock using natural materials.

2.9 Students will describe the rock cycle.

*2.10 Students will identify descriptions and examples of physical weathering and chemical weathering.

+2.11 Students will describe the effect of soda water on limestone.

+2.12 Students will tumble sugar cubes to demonstrate physical weathering.

*2.13 Students will identify the composition of humus.

2.14 Students will describe how soil is formed.

+2.15 Students will determine composition of soil when given a soil sample.

2.16 To demonstrate knowledge of ground water, students will identify a definition of porosity and permeability.

2.17 Students will explain the fluctuations of the water table.

+2.18 Students will describe the relationship of particle size to porosity when given soil samples.

*2.19 Students will identify the Floridan aquifer as the source of Northeast Florida water supply.

2.20 Students will identify how limestone caverns and sinkholes form.

3.0 Earth Activity

*3.1 Students will identify on a diagram the location of the crust, mantle, and core.

3.2 Students will explain the theory of plate tectonics.

3.3 To demonstrate knowledge of earthquakes, students will:

*(1) identify the activity which results in a fault;

(2) explain the relationship between plates, faults, and earthquakes;

*(3) identify the function of a seismograph;

(4) identify earthquake locations when given appropriate data; and

+(5) observe the difference in the rate of speed of primary and secondary waves by using laboratory methods.

3.4 To demonstrate knowledge of volcanoes, students will:

*(1) identify the location of magma and lava;

(2) describe the structure of a volcano;

(3) discuss the events which took place during the 1980 eruption of Mt. St. Helens; and

(4) identify volcano locations when given appropriate data.

*3.5 Students will identify descriptions of weathering and erosion.

*3.6 Students will identify processes of the water cycle from a diagram.

3.7 Students will describe the manner in which running water erodes.

*3.8 Students will identify a definition of glacier.

3.9 Students will identify the regions where wind erosion occurs.

*3.10 Students will identify how shoreline erosion occurs.

+3.11 Students will use ice cubes and sand to demonstrate glacial changes on the earth's surface.

+3.12 Students will demonstrate the relationship of soil particle weight to distribution by the wind.

4.0 Weather

*4.1 Students will identify nitrogen and oxygen as the major gases present in the atmosphere.

4.2 Students will list the sources of air pollutants.

*4.3 Students will identify the function of a barometer.

4.4 To demonstrate knowledge of atmospheric energy, students will:

(1) explain how the greenhouse effect heats the atmosphere;

*(2) identify a definition of convection;

(3) explain the differences in surface heating rates;

+(4) use a candle and a match to demonstrate convection; and

+(5) demonstrate the difference in the heating rate when given soil and water samples.

*4.5 Students will identify unequal heating as a cause of mountain, valley, land, and sea breezes.

4.6 To demonstrate knowledge of water vapor, students will:

*(1) identify a definition of humidity and relative humidity;

*(2) identify the function of a wet and dry bulb thermometer;

+(3) measure relative humidity using a wet and dry bulb thermometer;

*(4) identify a definition of condensation; and

(5) distinguish between conditions necessary to form dew and frost.

4.7 To demonstrate knowledge of clouds, students will:

(1) state the conditions necessary for cloud formation;

*(2) identify the three types of clouds; and

+(3) determine dew point.

*4.8 Students will identify a description of climate.

4.9 To demonstrate knowledge of severe weather conditions, students will:

(1) describe the conditions which favor the formation of a thunderstorm and lightning;

*(2) identify precautions to be taken during a hurricane and a tornado; and

(3) identify the path of a hurricane when given appropriate data.

4.10 To demonstrate knowledge of weather forecasting, students will:

*(1) identify the functions of weather instruments: thermometer, anemometer, rain gauge, and wind vane;

(2) list observations needed to predict weather changes;

(3) describe information given on a weather map; and

(4) explain how a weather prediction is made.

5.0 Solar System and Space Exploration

*5.1 Students will identify rotation of the earth as the reason for day and night.

*5.2 Students will identify revolution as the movement of planets around the sun.

5.3 Students will explain how gravity affects objects on the earth.

*5.4 Students will identify the shape of the earth's orbit.

5.5 To demonstrate knowledge of the moon, students will:

*(1) identify the moon as the natural satellite of the earth;

(2) identify the moon's phases;

(3) identify the period of revolution;

*(4) identify the position of the sun, earth, and moon when given a diagram of a lunar eclipse; and

(5) identify four ways conditions on the surface of the moon are different from conditions on the surface of the earth.

5.6 To demonstrate knowledge of the sun, students will:

*(1) identify the definition of sunspots;

(2) identify the source of the sun's energy; and

+(3) separate white light into its colors.

*5.7 Students will identify the function of the telescope.

5.8 To demonstrate knowledge of the structure of the solar system, students will:

*(1) identify the correct order of planets according to their distance from the sun;

(2) describe individual characteristics of the planets;

(3) compare the properties of asteroids, meteors, and comets; and

+(4) draw scaled models of planet orbits.

5.9 To demonstrate knowledge of stars, students will:

*(1) identify a description of a constellation of stars;

(2) explain why stars have different colors;

(3) identify the stages in the life history of stars; and

(4) distinguish between a galaxy and the universe.

5.10 To demonstrate knowledge of NASA (National Aeronautics and Space Administration), students will:

*(1) identify NASA as the official government space agency; and

(2) identify major functions of NASA.

6.0 Oceanography

6.1 To demonstrate knowledge of the sea floor, students will locate the physical features of the sea floor.

6.2 To demonstrate knowledge of salinity, students will:

(1) identify a definition of salinity; and

(2) identify the two most abundant elements in sea water.

6.3 To demonstrate knowledge of ocean movement, students will:

(1) identify a description of currents;

(2) describe causes of currents;

+(3) determine the density of a given water sample;

(4) describe the path of North Atlantic currents;

+(5) demonstrate the effect of wind on water to form a current; and

+(6) perform an experiment to illustrate the effect of density on the distribution of currents.

6.4 To demonstrate knowledge of waves, students will:

(1) identify the cause of surface waves;

(2) identify the location of the parts of a wave;

(3) describe the formation of breakers; and

(4) explain causes of tides.

KEY TO RECOMMENDED INSTRUCTIONAL MATERIALS

Performance Objective		Instructional Implications		Resources	
Number	Topic	Teaching Time	Tested on	County Adopted	Supplementary
1.0	Research Skills	2 weeks	MLST	W. L. Ramsey, et al, Holt Earth Science (New York: Holt, Rinehart, and Winston, Inc., 1978), pp. 1-13.	W. L. Ramsey, et al, Holt Earth Science Resource Book (New York: Holt, Rinehart, and Winston, Inc., 1978), pp. 1-37.
2.0	Earth Composition	6 weeks	MLST	Ramsey, pp. 132-240.	Ramsey, pp. 79-115.
3.0	Earth Activity	6 weeks	MLST	Ramsey, pp. 16-95.	Ramsey, pp. 39-65.
4.0	Weather	7 weeks	MLST	Ramsey, pp. 244-312.	Ramsey, pp. 117-35.
5.0	Solar System/ Space Exploration	7 weeks	MLST	Ramsey, pp. 370-450.	Ramsey, pp. 157-87.
6.0	Oceanography	4 weeks		Ramsey, pp. 313-67.	Ramsey, pp. 137-55.

County Adopted Text:

W. L. Ramsey, et al, Holt Earth Science (New York: Holt, Rinehart, and Winston, Inc., 1978).

KEY TO LABORATORY RESOURCES

Objective	Skill	County Adopted Text Pages	Other Resources
	Students will:		
+1.3	determine the mass and density of a rock using appropriate laboratory equipment.	78, 10-12	
+2.3	test the degree of hardness of objects using the scratch test and the mineral hardness scale.	146-47	S. M. Eisler, et al, Lab - Inquiry Text: Earth Science (New York: Cambridge Book Company, 1974), pp. 41-43.
+2.5	determine the relationship between cooling rate and crystal size by experimentation.	155-56	
+2.7	use modeling clay to demonstrate the formation of metamorphic rock.	166-67	
+2.8	construct a model of sedimentary rock using natural materials.	170-72	Eisler, pp. 57-58.
+2.11	describe the effect of soda water on limestone.	177-78	Eisler, pp. 72-73.

KEY TO LABORATORY RESOURCES

Objective	Skill	County Adopted Text Pages	Other Resources
	Students will:		W. L. Ramsey, et al, Holt Earth Science Resource Book (New York: Holt, Rinehart, and Winston, Inc., 1978), p. 103.
+2.12	tumble sugar cubes to demonstrate physical weathering.	182-83	Ramsey, p. 103, Research 9. Eisler, pp. 67-69.
+2.15	determine composition of soil when given a soil sample.	188-89	
+2.18	describe the relationship of particle size to porosity when given soil samples.	188-89, 194-95	Ramsey, p. 104, Research 11. Eisler, pp. 50-53.
+3.3.5	observe the difference in the rate of speed of primary and secondary waves by using laboratory methods.	37-40	Eisler, pp. 92-95.
+3.11	use ice cubes and sand to demonstrate glacial changes on the earth's surface.	79-80	

KEY TO LABORATORY RESOURCES

Objective	Skill	County Adopted Text Pages	Other Resources
	Students will:		
+3.12	demonstrate the relationship of soil particle weight to distribution by the wind.	86-87	Eisler, pp. 83-85.
+4.4.4	use a candle and a match to demonstrate convection.	258	
+4.4.5	demonstrate the difference in the heating rate when given soil and water samples.	258-59	Ramsey, p. 125, Research 4, p. 135, Research 8. Eisler, pp. 116-21.
+4.6.3	measure relative humidity using a wet and dry bulb thermometer.	273	Ramsey, p. 135, Research 5. Eisler, pp. 163-69.
+4.7.3	determine dew point.	280-81	Ramsey, p. 135, Research 6. Eisler, pp. 153-54, 170-73.
+5.6.3	separate white light into its colors.	417-18	

KEY TO LABORATORY RESOURCES

Objective	Skill	County Adopted Text Pages	Other Resources
	Students will:		
+5.8.4	draw scaled models of planet orbits.	423-24	
+6.3.3	determine the density of a given water sample.	344-45	Ramsey, p. 145, Research 6.
+6.3.5	demonstrate the effect of wind on water to form a current.	351-52	Ramsey, p. 155, Research 1.
+6.3.6	perform an experiment to illustrate the effect of density on the distribution of currents.	364-66	